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DICTIONARY OF  
SCIENTIFIC TERMS



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# DICTIONARY OF SCIENTIFIC TERMS

AS USED IN THE VARIOUS  
SCIENCES

BY

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## AUTHOR'S INTRODUCTION

THIS little book of reference—for such it is intended to be rather than a dictionary pure and simple—is based on notations taken from recently published scientific books and from articles in scientific periodicals by recognized authorities. It would not be possible, in the allotted space, to furnish a complete list of all the authorities consulted during the past five years for this purpose. The writer makes no claim to originality of word description. His rôle has consisted in selecting those particular terms most likely to call for inquiry on the part of students and that ever-increasing intelligent section of the public who are interested in the discoveries consequent on the rapid march of science, and in providing, in the case of many words, a fuller explanation than the somewhat terse one given in most dictionaries. The unique feature of the book lies in the numerous cross-references, synonyms, and antonyms, which will, he hopes, enable users to hunt up quickly words of similar, related, and opposite signification.

CHARLES M. BEADNELL.

### NOTE TO SECOND EDITION

IN this new issue is included a Supplementary List (S.L.) of scientific words and expressions.

### NOTE TO THIRD EDITION

I TAKE this opportunity to thank those who have so kindly sent me suggested additions and amendments, as many as possible of which have been acted on. I am especially indebted to Mr. FitzGerald Lee and Mr.

J. M. A. Lenihan, M.Sc., Lecturer on Physics at King's College, Newcastle-on-Tyne. Thanks to the last-named, the radio-active transmutations of Actinium, Radium, Thorium and Uranium, and the values of many physical constants, have been brought into line with the latest research-work of physicists.

C. M. B.

# ABBREVIATIONS

|                   |   |
|-------------------|---|
| a.                | Adjective.  |
| Å.                | Angström unit of wave-length.                           |
| Abs.              | Absolute (temperature).                                 |
| Aer.              | Aeronautics.  |
| An.               | Animal, animals.  |
| Ant.              | Anterior.   |
| App.              | Applied to.   |
| Ast.              | Astronomy.  |
| At.               | Atom. Atomic.   |
| b.p.              | Boiling point.  |
| B.o.T.            | Board of Trade.   |
| bot.              | Botany.   |
| Bio.              | Biology.  |
| C.                | Carbon. Centigrade.                                     |
| c.                | <i>Circa</i> , about, approximately. <i>Cum</i> , with. |
| c.c.              | Cubic centimetre.                                       |
| Cert.             | Certain.  |
| Cf.               | Compare.  |
| Cfd. c.           | Compared with.  |
| Ch.               | Chemistry. Chemical.                                    |
| Cl.               | Class.  |
| cm.               | Centimetre.   |
| CO <sub>2</sub> . | Carbon dioxide. Carbonic acid gas.                      |
| Cub.              | Cubic.  |
| d.                | Diameter.   |
| deg.              | Degree.   |
| div.              | Division. Divided by. Divides.                          |
| E.                | East.   |
| e.g.              | For instance. For example.                              |
| E.M.F.            | Electro-motive-Force.                                   |
| El.               | Element.  |
| Elec.             | Electrical. Electricity.                                |
| Eq.               | Equal or equivalent, to.                                |
| Ev.               | Evolution; evolutionary.                                |
| Ex.               | For example. Example.                                   |
| f.                | Female, females.  |
| f.s.              | Feet per second.  |
| f.-w.             | Fresh-water.  |
| Fam.              | Family.   |
| freq.             | Frequency.  |
| ft.               | Foot. Feet.   |
| G., g.            | Gravitation.  |
| Gen.              | Genus.  |
| Geo.              | Geology; geological.                                    |
| gr.               | Gravity.  |
| H.                | Hydrogen.   |
| h.                | Hour.   |
| H <sub>2</sub> O. | Water.  |
| i.e.              | That is.  |
| id.               | Identical or identified with.                           |
| in.               | Inch.   |

|              |                                    |
|--------------|------------------------------------|
| kg.          | Kilogram.                          |
| kil., km.    | Kilometre.                         |
| l.           | Length.                            |
| Lat.         | Latitude.                          |
| lb.          | Pound.                             |
| Long.        | Longitude.                         |
| m.           | Male, males. Minute. Metre.        |
| <i>m.p.</i>  | Melting point.                     |
| <i>Math.</i> | Mathematics.                       |
| max.         | Maximum.                           |
| Mend.        | Mendelism.                         |
| min.         | Minimum.                           |
| mm.          | Millimetre.                        |
| mol.         | Molecule.                          |
| Mt.          | Mountain.                          |
| N.           | Nitrogen. North.                   |
| <i>n.</i>    | Noun.                              |
| neg.         | Negative.                          |
| No.          | Number.                            |
| O.           | Order. Oxygen.                     |
| <i>Opp.</i>  | Opposite. Opposed to.              |
| Opt.         | Optics.                            |
| Oz.          | Ounce.                             |
| p.           | Pressure.                          |
| p.c.         | Per cent.                          |
| <i>Per.</i>  | Pertaining or relating to; period. |
| <i>Phy.</i>  | Physics.                           |
| pl.          | Plant, plants. Plural.             |
| pos.         | Positive.                          |
| post.        | Posterior.                         |
| <i>Psy.</i>  | Psychology.                        |
| <i>q.v.</i>  | <i>Quod vide.</i> Refer to.        |
| S.           | South. Sulphur.                    |
| Sc.          | Science.                           |
| Sec.         | Second. Secondary.                 |
| Sing.        | Singular.                          |
| Sp.          | Specific.                          |
| sq.          | Square.                            |
| <i>Sym.</i>  | Symbol.                            |
| <i>Syn.</i>  | Synonymous with.                   |
| temp.        | Temperature.                       |
| <i>v.</i>    | Verb; <i>Vide</i> , see.           |
| <i>v.v.</i>  | <i>Vice versa</i> ; contrariwise.  |
| vel.         | Velocity.                          |
| vert.        | Vertebral. Vertebrate.             |
| vol.         | Volume.                            |
| W.           | West.                              |
| w.-l.        | Wave-length.                       |
| wt.          | Weight.                            |
| <i>Zoo.</i>  | Zoology.                           |

A complete list of Symbols and Signs will be found in the text under "Symbols." Use has been made of chemical formulæ where this does not involve ambiguity.

# DICTIONARY OF SCIENTIFIC TERMS

(Readers are referred to the List of Abbreviations on pp. ix-x)

## A

**Abactinal.** Surface of body in radiate an. opp. mouth. *Syn.* antambulacral.

**Abdomen.** Part of trunk between thorax and pelvis containing the viscera; in insects and zooids, etc., part of body behind thorax. *Syn.* belly; meso-, meta-soma; pygidium.

**Abduction, abductor.** Movement from median axis. Muscle causing such movement.

**Aberration.** (1) Non-convergence of light-rays to a focus. (2) Displacement of position of heavenly body due to combined effects of light-transmission delay, motions of luminous source and observer.

**A., chromatic.** Convergence of "coloured" light-rays by a convex lens to different foci—each colour having a sp. focus. **A., spherical.** Bringing, by the central and marginal zones of a convex lens, white light-rays to different foci.

**Abiogen-esis, -y.** Transformation of lifeless into living matter, especially the first transformation (c. 1500 million to 2000 million years ago) from the inorganic compounds (salts, gases, and water) of the earth's crust. *Syn.* archebiosis; archigenesis, -gony; auto-genesis, -gony; plasmogony; spontaneous generation.

**Abomasum.** Fourth, or true, stomach of ruminants. Read.

**Aboral Pole.** Opp. end to mouth. Anus.

**Abort.** To cut short, dwindle, become sterile, remain undeveloped, or give birth to a non-viable or dead offspring.

**Abranchiate.** Without gills.

**Abscess.** A collection of pus (*q.v.*).

**Absciss, abscissa.** A layer of separation. **Septum.** (1) Cell-layer (outside cork-layer) at base of petiole which "breaks" when a leaf is shed. (2) One of two elements of reference by which a point (*e.g.*, of a curve) is referred to a system of fixed rectilinear co-ordinate axes; the other el. being the *ordinate*, the two together forming the co-ordinates. When a point is referred to two intersecting axes, the one is the *axis of abscissas*, the other the *axis of ordinates* (*q.v.*).

**Absolute.** Perfect. Complete. Whole. Free of all relationship. Unconditioned. Ultimate reality. Independent of arbitrary measuring standards. **A. magnitude.** Magnitude of a heavenly body in terms of a scale that assumes the body to be 32.6 light-years distant. An *average* giant star, *e.g.*, has a. m. of + 1, our sun + 5, average faint dwarf star + 13. **A. temperature.** Temperature (*q.v.*) measured in



degs. C. from point where all thermal molecular motion ceases—i.e.,  $0^{\circ}$  Abs. =  $-273.16^{\circ}$  C. =  $-459.7^{\circ}$  F. A t. of  $-272.8^{\circ}$  C. has been attained.

**Absorption** (cf. Adsorption). Disappearance through inclusion or incorporation in something else with or without loss of its separate existence. Solution of gas or solid in a liquid. Process of rendering solids soluble and diffusible and of incorporating dissolved materials in cellular tissues. Disappearance, as such, of radiations (light, heat, etc.) in passing through gases, liquids, or solids. **A.**, coefficient of. (1) The a. of a gas is proportional to its partial p. in the atmosphere; the c. of a. is a measure, after equilibrium is attained, between the concentration of a substance in solution and in the gaseous state. The c. of a. is the vol. of a gas absorbed by 1 litre of the liquid at 760 mm. p.; it varies with t., thus: c. of a. of  $\text{CO}_2$  at  $0^{\circ}$  C. = 1.797; at  $20^{\circ}$  C. = 0.901; at  $100^{\circ}$  C. = 0.244. (2) Ratio of intensity of radiation (or of a sound-wave) absorbed to that of incident radiation or sound-wave. **A. bands.** Dark bands in a. spectrum caused by solids or liquids in absorbing medium. **A. lines.** Dark lines in a. spectrum due to gases or vapours in absorbing medium. **A. spectrum.** Spectrum showing by their absence the radiations a substance fails to transmit.

**Abstraction.** Consideration of a thing or attribute independently of all else—e.g., of

"yellowness" or "whiteness" apart from the object—the lemon or snow.

**Abstriction.** Detachment or cutting off—e.g., of spores by the rounding off of tips of sporophores or by formation of septa.

**Abyss.** Ocean below 1800 ft. Abyssal zone. Cf. Coralline zone. **Abyssal.** *Syn.* bathypelagic. **A. fauna.** Sponges, coelenterates, worms, echinoderms, crustaceans, molluscs, fishes—most of them highly phosphorescent. **A. zone.** *Abyss (q.v.).*

**Acanaceous.** Thorny, prickly. **Acanthocarpous.** Having prickly fruit. **Acanthoclados.** Having thorny branches.

**Acapnia.** Condition of  $\text{CO}_2$  deficiency.

**Acarina.** O. of Arachnids including cheese-, follicle-, mange-, itch-, gall-, beetle-, and bee-mites, also ticks.

**Acceleration.** Rate of change (increase or decrease per sec. per sec.) of vel. per unit of time.

Decreasing rate = *deceleration*. When vel. of a point changes at rate of 1 cm. per sec., it has unit a. The ratio is force/mass. Gravity (*q.v.*) is a force imparting an unvarying amount of a. per sec. to the vel. of a body. *Ast.* (1) Time a star daily gains upon the sun in passing the meridian. (2) The increased vel. with which planets pass from aphellion to perihellion. (3) Slight increase in moon's mean vel. *Ch.* Rate of change of vel. of a reaction.

**A., angular.** Rate of change of angular vel. The unit is one radian per sec. per sec.

**Accrescence.** Continuous growth—e.g., of pl. or of calyces after fertilization. **Accretion.** Growth by adhesion

of external parts. Growth of crystal by addition of new matter to outer surface. *Opp.* intussusception.

**Accumbent.** Lying against a part—*e.g.*, cotyledons against hypocotyl. *Cf.* Incumbent.

**Accumulator.** Storage, or secondary, battery. Group of cells which, having been charged by passage of direct current, is itself capable of subsequently furnishing a current. **A. capacity.** Ampere-hour capacity.

**Acentric, -ous.** *App.* vertebræ without centra, but with persistent notochord.

**Acephal-a.** (1) Headless organisms. (2) Div. of molluscs. **Acephalocyst.** Hydatid. **Acephalous.** (1) Headless. *Cf.* Eucephalous. (2) Having style arising from base of ovary.

**Acerose, -ate, -ous.** Sharp-pointed.

**Acerulus.** Cluster of sporogenous mycelium. Agglomeration of ammonio-magnesium phosphate in brain. Brain-sand. *Corpora amylacea.*

**Acetabulum.** Any cup-shaped space. Socket accommodating head of femur or leg of insect. A "sucker" (cephalopod, leech). Placental cotyledon.

**Acetic acid.** Vinegar.  $C_2H_4O_2$ .

**Acetone.** An aldehyde-like body present in wood-spirit and diabetic urina.  $C_3H_6O$ .

**Achene.** Small, dry, indehiscent, seed-like, fruit. A monospermal seed-vessel which does not open and in which a single loose seed lies within the pericarp. *Ex.* buttercup.

**Achlamyde-al, -ate, -ous.** *Bot.* devoid of perianth. *Syn.*

*gymnanthous.* *Zoo.* devoid of mantle.

**Achondroplasia.** Deficiency of cartilage leading to *dwarfism* in which limbs are stunted but trunk is normal. *Cf.* Ateleosis.

**Achromatic.** Uncoloured. Transmitting "white" light without decomposing it. **A. lens.** A lens that "corrects" colour-rays to "white" light. *Ex.* A biconvex plus plano-concave lens of different refractive and dispersive powers. **A. spindle.** Spindle of colourless threads uniting attraction spheres. *See* Karyokinesis. **Achromatin.** Unstainable nuclear hyaloplasm. **Achromatoplasm.** Unstainable reticular matrix of cell; the conducting material of nerve-cells. **Achromatopsia.** Colour-blindness.

**Acicular.** Sharp-pointed.

**Acid.** A hydrogen-containing substance that neutralizes an alkali or base, turns blue litmus red, and (usually) is electro-negative.

An electrolyte with a H atom as one dissociation product replaceable by positive element or radical to form a salt. A compound dissociating in watery solutions with production of H ions. *See* Normality; pH; in S.L.

**Acinus.** Small sac, seed, berry, or kernel. One of a grape-like cluster of berries. **Drupelet.** Sac-like end of racemose gland.

**Accelomata.** Accelous (*q.v.*) animals. *Ex.* sponge. **Accelous.** Without body-cavity.

**Acotyledons.** Cl. of pl. without cotyledons. *Ex.* fern.

**Acoustics.** Science of sound. **Acquired adaptations.** Three

types: (1) *Primary A.* Grasping toe of arboreal marsupials (opossum), whose ancestors were terrestrial. (2) *Secondary A.* Loss of toe-grasping power in terrestrial marsupials (kangaroo) with arboreal ancestry. (3) *Tertiary A.* Long claws and broadened foot of arboreal marsupials (tree-kangaroo) with proximate terrestrial and remote arboreal ancestry. **A. characters.** Modifications of the body appearing during the lifetime of the individual in consequence of disease, injury, use, disuse, etc. **Syn.** acquired variation.

**Acrania.** Lowest (skull-less) vertebrates. Cephalochordata. *Ex.* amphioxus (*q.v.*).

**Acrasiales.** Grouped amoeboid cells which do not form a true plasmodium.

**Acre.** 43,560 sq. ft. (U.S.), 0.0015625 sq. mile. 4046.873 sq. met. (U.S.), 4046.849 sq. met. (Br.), 4840 sq. yds. (Br.).

**Acrocephaly.** Dome-shaped head as *cf.* d. c. flat-crowned head in platycephaly. **Acrodont.** Tooth basi-fixed to jaw; an. (*ex.* lizard) with such teeth.

**Acrogamy.** Having ovule at apex of embryo-sac. **Porogamy.** Acrogens. Higher cryptogams (fern, moss). **Syn.** archegoniates. **Acromegaly.** Gigantism due to activity of pituitary after normal growth has ceased. **Acrophobia.** Morbid fear of heights. **Aerosome.** Substance of head of spermatozoon. **Acrospore.** Spore at apex of sporophore.

**Actine.** Having rays or spines. **Actinia.** Sea-anemones, etc. **Actinic.** *Per.* rays or radiations or to chemically-effective energy. **Actinium, ch.**

*el.* Ac. Radio-active *el.* **At.** no. 89; *at. wt.* 227.

The evolution and break up of this element (following Morgan and Bur-stall's *Inorganic Chemistry*) is shown below. Atomic numbers and weights are respectively indicated on the left and right of the symbols of the *el.* The three types of radiation are alpha particles (or helium nuclei)  $\alpha$ , beta particles (or electrons)  $\beta$  (also by  $e^-$ ), and gamma waves,  $\gamma$ . l.p. indicates the average life-period and  $\rightarrow$  stands for "becomes" or "dis-integrates to." Note that the loss of  $\alpha$ -particle decreases *at. wt.* by 4 and *at. no.* by 2; expulsion of an electron increases *at. no.* by 1 but is without effect on *at. wt.*; expulsion of  $\gamma$ -wave alters neither *at. no.* nor *at. wt.*

Actinouranium ( $_{88}\text{U}^{238}$ ), l.p.  $7.13 \times 10^8$  years; expels  $\alpha \rightarrow$   
Actinium Y ( $_{86}\text{Th}^{234} + {}_2\text{He}^4$ ), l.p. 24.6 hr.; expels  $\beta, \gamma \rightarrow$   
Protoactinium ( $_{81}\text{Pa}^{231} + e^-$ ), l.p.  $3.2 \times 10^4$  years; expels  $\alpha, \gamma \rightarrow$   
Actinium ( $_{89}\text{Ac}^{227} + {}_{88}\text{Ra}^{226}$ ), l.p. 13 years; expels  $\beta, \gamma \rightarrow$   
Radio-actinium ( $_{88}\text{Th}^{227} + e^-$ ), l.p. 18.9 days; expels  $\alpha, \gamma \rightarrow$   
Actinium X ( $_{82}\text{Ra}^{226} + {}_2\text{He}^4$ ), l.p. 11.2 days; expels  $\alpha, \gamma \rightarrow$   
Actinon (An or  $_{81}\text{Rn}^{219} + {}_2\text{He}^4$ ), l.p. 3.92 secs.; expels  $\alpha, \gamma \rightarrow$   
Actinium A ( $_{84}\text{Po}^{218} + {}_2\text{He}^4$ ), l.p. 0.002 sec.; expels  $\alpha \rightarrow$   
Actinium B ( $_{83}\text{Pb}^{214} + {}_2\text{He}^4$ ), l.p. 36.1 mins.; expels  $\beta, \gamma \rightarrow$   
Actinium C ( $_{82}\text{Bi}^{214} + e^-$ ), l.p. 2.16 mins.; expels  $\alpha, \beta, \gamma \rightarrow$  (1).  
 $\rightarrow$  (2).  
(1) 0.3 p.c. Actinium C' ( $_{81}\text{Po}^{214} + e^-$ ), l.p. 0.005 sec.; expels  $\alpha \rightarrow$   
Actinium D ( $_{82}\text{Pb}^{214} + {}_2\text{He}^4$ )  
(2) 99.7 p.c. Actinium C'' ( $_{81}\text{Ti}^{214} + {}_2\text{He}^4$ ), l.p. 4.76 mins.; expels  $\beta, \gamma \rightarrow$   
 $_{83}\text{Pb}^{214} + e^-$ .

**Actinomorphie.** Radially symmetrical. *Ex.* starfish. **Actinozoa.** Radiate ans. Coelenterates. Anthozoa. Include jelly-fish, anemones, corals, zoophytes, etc.

**Action.** Product of *energy* and *time*. Biologically there are four types: automatic, reflex, instinctive, and volitional. **A. time.** Time be-

tween stimulation and response. Reaction time. Latent period.

**Aculeate.** Possessing sting, prickles, etc. **Acuminate.** Tapered.

**Acyclic.** Not periodic. **Aliphatic.** Not whorled.

**Adamantoblast.** Enamel-forming cell. **Ameloblast.**

**Adaptation.** Processes of change in structure, function, or habits of an organism, whereby it becomes adjusted to and fits in with its surroundings.

**Addict.** One self-bound to use of a drug.

**Adduction.** Bringing a limb, etc., towards main axis. Approximation of two similar parts (ex. fingers). Closure of bivalve.

**Adelocodonic.** *App.* zooids that remain attached to colony. *Cf.* **Phanerocodonic.** **Adelomorph-ic, -ous.** Indefinite in structure.

**Adelphous.** United in bundles. *Ex.* stamens.

**Aden-iform, -oid.** Lymphoid. Gland-like. Hypertrophied nasal lymphoid tissue. **Adenophyllous.** Having leaf-glands.

**Adeps.** Animal fat.

**Adhesion.** Sticking together due to surface molecular attraction. Union of dissimilar parts (calyx to ovary). *Cf.* Cohesion.

**Adiabatic.** Neither losing nor gaining heat. **Adiathermal, -anous.** Athermanous.

**Adipocere.** Fat (of corpse) decomposed to ammonium margarate. **Adipose.** Rich in fat cells.

**Adnate.** Attached by whole surface, as of stipule, leaf, etc., or of another basifixed to filament, or of zooid to colony stem.

**Adoral.** Near mouth.

**Adrenal.** Suprarenal gland. A hormone-secreting gland near kidney. Secretion of *cortex* of gland regulates development and sex-organs, the *medulla* of the gland secretes **Adrenalin**, a hormone poured out in terror or rage which increases sugar in, and raises p. of the blood, and strengthens and quickens the heart's action.

**Adsorption.** Adhesion of mols. to solid bodies. Condensation of gases on solids. Enhanced concentration of solute near surface of solids. Condensation of dissolved substances on surface of liquids or solids. Feeble union of neutral salts with water as "water of crystallization." Invisible layer of moisture on cold surface. Adhesion of gas to glass of exhaust tube. Occlusion of gases or moisture in spongy metals or carbon. *See* Surface tension. *Cf.* Absorption; Occlusion.

**Æcidiocarp.** Sporocarp.

**Æcidiospores.** Spores in **Æcidium**. Cup-shaped structure in fungi containing sporophores.

**Æcium.** Spore-producing organ.

**Ælurophobia.** Morbid fear of cats.

**Æolotropy.** Change of physical qualities—e.g., light transmission due to change of position. **Anisotropy.**

**Æpyornis.** Extinct bird of Madagascar. Its egg, 14 in. d. = 148 hen's eggs.

**Ærobe.** Organism that dies in absence of free O. *Cf.* **Anærobe.**

**Ærolite.** Meteorite containing more stone than iron. *Cf.*

**Ærosiderite.** *Syn.* **ærolith,**

**Ærolith.** *Ærolite* (*q.v.*). **Ærophyte.** Pl. attached to aerial part of another pl. **Ærosiderite.** Iron meteorite. *Cf.* **Ærolite.** **Ærosphere.** Atmosphere. **Ærostat.** Air-sac. Lighter-than-air aircraft. **Ærotaxis.** **Ærotropism.** Response to higher or lower oxygen content. **Pneumo-taxy, -tropism.**

**Æsthes-ia, -is.** Feeling; sensation. *Cf.* **Anæsthesia.**

**Æstivation.** Dormancy during drought. Arrangement of flower-parts especially during *prefloration*.

**Æthaliu.** Aggregation of plasmodia.

**Ætiology.** Study of causation, especially as regards diseases.

**Affect.** Feeling. Emotion. Psychic complex governing behaviour.

**Afferent.** Conducting towards a centre or brain. *App.* sensory nerves. Centripetal. *Cf.* **Efferent.** **A. arc.** Receptor plus conductor. *See* **Reflex arc.**

**Affinity.** Similarity in essential organs. Structural resemblance. Chemical attraction. Union of substances to form a compound.

**After-shaft.** **Hypo-rachis, -ptilon.**

**Agamete.** A cell which grows to adult form without uniting with another cell. **Agamic.** Reproduction by f. without impregnation by m. **Asexual.** **Parthenogenetic.** *Per.* **agamy** (*q.v.*). **Agamobium.** **Asexual** generation in alternation of generations. *Cf.* **Gamobium.** **Agamogenesis, -gony.** **Parthenogenesis.** **Schizogony.** **Agamy.** **Agamont.** Mother-cell of aga-

**mete.** **Schizont.** **Agamospore.** **Asexual** spore. **Agamous.** **Asexual.** **Agamy.** Absence of sex organs. **Agamogenesis** (*q.v.*).

**Ageotropism.** **Apogeotropism.**

**Agglomerate.** Non-rounded, fused, volcanic fragments. *Cf.* **Conglomerate.** A group of organisms, a plasmodium, a flower-head.

**Agglutination.** Act of adhesion, especially formation of "clumps" of bacteria, cells, etc.

**Agnathostomatous.** Jawless. **Agomphious.** Toothless.

**Agonist.** A muscle opposed in action to an antagonist (*q.v.*). *Syn.* **Protagonist.**

**Agoraphobia.** Fear of open spaces, or of publicity.

**Aheliotropism.** **Apheliotropism.**

**Air.** Mechanical gaseous mixture surrounding earth, taking part in an. and pl. respiration, and supporting combustion. *See* **Atmosphere.**

The air exercises 14.73 lbs. p. on each sq. in. of objects at sea-level. Total weight is  $11.7 \times 10^{12}$  tons. It liquefies at  $-200^{\circ}\text{C}$ . and if whole atmosphere became liquid it would form a layer 35 ft. deep over entire globe. In composition air is:—

Nitrogen, 784.0 (vol.), 759.5 (wt.); oxygen, 209.4 (vol.), 231.0 (wt.); argon, 6.3 (vol.), 9.0 (wt.); carbon dioxide 0.3 (vol.), 0.5 (wt.).

**A.-bladder.** *Syn.* **pneumatocyst, -phore.** Swim-bladder of fishes.

The a.-b. is a *hydrostatic* organ enabling the fish by compressing it to sink, by relaxing it to rise, in water. In cert. vocal fishes it also acts as a *resonator*. In dipneusts it is further an *accessory respiratory organ*. It is absent in cyclostomes, only a trace of it exists in sharks, it is single in lepidosteus and neo-ceratodus, double in electric "eel" and polyp-

terus, while in pretopterus and lepidosiren it is double and lung-like.

**A.-cells.** Any a.-filled spaces such as mastoid bone of man, a.-sacs of birds. Specifically the sac-like endings of a.-tubes in lung. **A.-pocket.** Local down-current, or a sudden change of wind velocity in direction of travel.

**Akaryote.** Non-nucleated cell. Protist. **Akinete.** Resting-cell.

**Alar.** *Per.* wings.

**Alasotonic.** *App.* pl. movements induced by external stimuli as *cf.* a. auxotonic or internal growth movements.

**Alate.** Winged; tipped.

**Albedo.** Degree of whiteness. Ratio of sunlight reflected from, to sunlight falling on, a body. *Ex.* a. of moon is 0.073—*i.e.*, moon absorbs 73 and reflects 927 parts per 1000 of sunlight. **Albinism.** Absence of pigment in skin, hair, eyes, feathers, etc. In pl. due to colourless chromatophores—*i.e.*, absence or ill-functioning of chloro- and chromo-plasts. *Opp.* melanism in which there is excess of pigment in cells.

**Albumen.** One of many proteids. White of egg. **Albumin.** A mixture of proteins of living matter and its products (flesh, blood, milk, lymph, sap, roots, seeds, etc.). Approximate formula  $(C_{242}H_{331}N_{45}O_{71}S)_x$ , where  $x$  is at least 3. **Albuminoid.** Resembling albumen. Protein, globulin, peptone, etc.

**Albumum.** Sap-wood; the softer and younger wood between the bark and true wood.

**Alcohol.** Hydroxide of organic radical, or water with one H atom replaced by

hydrocarbon radical. Common, or ethyl, alcohol is  $C_2H_5O$ . General formula  $H_2O + nCH_2$ .

**Aldehyde.** Dehydrogenated alcohol; a colourless, volatile liquid. Methyl alcohol,  $CH_3O - H_2 =$  methyl aldehyde,  $CH_3O$ .

**Alecithal.** Having little yolk.

**Aleurone.** An albuminoid, reserve-food particle in pl. protoplasm.

**Algæ.** Sea and f.-w. weeds. Primitive, aquatic cryptogams. Include chloro- (green), phæo- (brown), rhodo- (red), and cyano- (blue) phyceæ.

**Algonkian.** A late proterozoic era.

**Alimentary canal.** Digestive tube; mouth, pharynx, cesophagus, stomach, duodenum, jejunum, ileum, colon, rectum, and anus.

**Aliphatic, ch.** Having open-chain structure.

**Alkali.** Compound, usually electro-positive, which neutralizes an acid and turns red litmus blue. **Base.** **Alkaloid.** Complex, alkali-like, usually poisonous, pl. extractive. *Ex.* strychnine. *See* pH (S.L.).

**Allantois.** A water-filled, membranous sac in reptiles, birds, and mammals, which protects, nourishes, and provides O to, the embryo foetus.

It arises from the embryo's hind-gut, and is really the modified urinary bladder of ancestral amphibians.

**Allelomorph.** *See* Mendelism. Either of any pair of contrasting Mendelian characters.

One of two dissimilar factors which, on account of their corresponding positions in corresponding chromosomes, are subject to alternative (Mendelian) inheritance. Genes occupying identical loci in homologous chromosomes.

**Allergy.** Changed reactivity—dependent on newly-acquired characteristics—on second, or subsequent blood, or tissue, inoculation.

**Allogamy.** Cross-breeding (*q.v.*). *Cf.* Autogamy.

**Alloigenesis.** Alternate sexual and asexual reproduction. **Allopelagic.** Present at all depths. **Alloplasm.** Highly differentiated plasm. **Alloplast.** Cell capable of originating different tissue types. **Allopolyploid.** Polyploid whose chromosomes do not usually form multivalents at meiosis.

**Allosome.** Non-typical chromosome. *Cf.* Autosome. **Allosyndesis.** Pairing, in a polyploid, of chromosomes from different parents. *Cf.* Autosyndesis. **Allotropy.** Variation of properties without change of substance. *Ex.* C exists as soot, charcoal, and diamond. *Cf.* Isomorphism.

**Alloy.** A mixture of 2, 3, or more metals (or non-metals). *Ex.* copper + zinc = brass.

**Alluvial.** Post-glacial epoch. *Per.* alluvium. **Alluvium.** Deposits (earth, sand, etc.) by rivers that have since altered course.

**Alopecia.** Loss of hair.

**Alpha particle.** Nucleus of helium (or structural equivalent in nuclei of other elements).

Atom of He less two planetary electrons. An *a.p.* is composed of 4 protons + 2 nuclear electrons; it is therefore *positively* charged. The *a.p.* is expelled from nucleus of radioactive atoms at *vel.* = 8,800 (*ex.* U) to 12,800 (*ex.* Th) miles per sec. Taking 0 at 16, its mass is 4.002. The *a.p.* is deflected by magnet. *See* S.L.

**A. ray.** Stream of *a.* particles. *See* Neutron.

**Alternating current.** Electric current which periodically varies in magnitude and direction. From zero to maximum and back to zero, thence to maximum and back to zero in *reverse direction*, is one *cycle*; a half-cycle is one **Alternation** (+ or -). **Alternation of generations.** *Mend.* Occurrence of two series of nuclear divisions in one life-cycle—a haploid and a diploid. *Bot. Zoo.* Occurrence in one life-history of both *sexual* and *asexual* forms.

*Ex.* (1) (Ferns) *gametophyte* (prothallus) of sexual generation gives rise to *antheridium* and *archegonium*, which respectively produce *spermatozooids* and *oospheres*. Two latter fuse and form *oospores*, from which arise *sporophytes* (ferns) of asexual generation. These produce *sporangia* containing *sporoids* (asexual "spores"), from which arise, once again, sexual gametophytes. (2) (Mosses). A *gametophyte* (the moss pl.) produces *antheridium* and *archegonium*, which respectively produce *spermatozoid* and *oosphere*. Two latter unite and form fertilized ovum or *oospore*. This, remaining attached to moss pl., grows on it into a stalked *sporophyte* bearing at its summit *spores*. These, falling to ground, grow into thread-like *protonemas*, from each of which, once again, is budded off the *gametophyte*. The *conspicuous pl.* is thus the asexual sporophyte in ferns, the sexual gametophyte in mosses. (3) Liver flukes of sheep and man. *Fertilized ovum* set free in intestine is shed on to grass and develops into a ciliated embryo, the *miracidium*, which, reaching water, bores its way into a water-snail, drops its cilia, and becomes a *sporocyst*, inside which are developed *broods of worm-like rediae*, which, after many generations, become *tailed cercariae*. These, leaving the snail, crawl on to grass and become *cysts*, and one of these, swallowed by sheep (or other host), develops in intestine into a *trematode worm*, which burrows its way into liver as a *fluke*, discharging *ova* and *sperms* as it does so. These, uniting,

produce *fertilized ova* which, shed on to grass, complete cycle. *Sec* Apogamy.

**Altrices.** Birds born in immature, helpless state and which must therefore be fed by parents and housed in a nest. *Syn.* *nidicolæ*. *Cf.* *Præcoces*.

**Alum.** Double sulphate of mono- and tri-valent elements. *Sym.*  $KAl(SO_4)_2 \cdot 12H_2O$ . **Aluminium, ch. el.** Al. Metal. *At. no.* 13; *at. wt.* 26.97.

**Alveol-a, -us.** Small cavity. Tooth socket or part of jaw containing teeth. *Faveolus*.

**Amalgam.** Soft mercury alloy.

**Amber.** Fossilized tree-resin. **Ambergris.** Waxy pathological product (allied to cholesterolin) of sperm-whale.

**Amblypoda.** Eocene ungulates with elephantine feet and gait. **Amblystoma.** American salamander whose larval form is *Axolotl* (*q.v.*).

**Ameloblasts.** Adamantoblasts.

**Ament.** (1) Catkin. (2) Idiot.

**Ametabola.** Insects with no, or little, metamorphosis, whose new-born young resemble parents. Hemi-, hetero-, paurometabola. *Ex.* cockroach. *See* Holometabolism.

**Amides.** Generic name of derivative ammonias obtained by exchanging H atoms in ammonia for an acid radical.

**Amines.** Ammonia derivatives obtained by replacing H atom by metal or alcohol. **Amino-acid.** Hydrolysed protein. Acid in which part of H has been replaced by amino-group; a mol. of protein is a group of amino-acid mols.

**Amitosis.** Direct cell, and

nucleus, div. Cell div. without thread-like formations (chromosomes, asters, etc.) of nucleus. *Holoschisis. Cf.* *Mitosis*.

**Ammocoetes.** Larva of lamprey; it represents a transitional stage in evolution of vertebrates.

**Ammonia.**  $NH_3$ . Colourless, pungent, soluble, alkaline gas.

**Ammonite.** Extinct tetra-branchiate cephalopod.

**Ammonium.**  $NH_4$ . Radical of ammonia salts.

**Amnesia.** Loss of memory.

**Amnion.** Membrane in mammals, birds, and reptiles, enclosing amniotic fluid in which embryo and fœtus are immersed. *Cf.* Allantois. **Amniotes.** Vertebrates possessing amnion and allantois.

**Amœba.** Type of rhizopod protozoa. **Amœbocyte.** Amœboid cell. **Leucocyte.**

**Amorphous.** Unorganized. Non-crystalline. Undifferentiated. Shapeless. *Geo.* without stratification or cleavage. *Syn.* *anamorphous*.

**Ampère.** Unit of intensity of elec. current. Current sent by 1 volt through 1 ohm.

**International A.** = unvarying elec. current which, passing through standard watery solution of silver nitrate, deposits 0.001118 gm. of silver per sec.; it is = 0.99995 abs. a. One a. = 1 coulomb per sec. =  $6.3 \times 10^{18}$  electrons per sec. =  $10^{-2}$  c.g.s. E.M.U. current =  $3 \times 10^9$  c.g.s. E.S.U. current. In other words, in a current of one a. 3,000,000,000 electrostatic units flow across each or any complete section of a conductor per sec.

In the electrolysis of an aqueous solution of HCl a current of one a. evolves 0.01044 mg. of H at the cathode per sec. (or twice that amount in 2 secs.), and 0.368 mg. of Cl at the anode per sec.

In the electrolysis of a silver chloride solution (AgCl) one a. deposits 1.118 mg. of silver on the cathode.



**A.-hour.** 3600 coulombs.

Quantity of electricity used up after an a. has been flowing for 1 hr.; e.g., a 24 a.-h. accumulator gives 1 a. for 24 hrs.,  $\frac{1}{2}$  a. for 48 hrs.,  $\frac{1}{4}$  a. for 96 hrs.

**Amphiaster.** The united twin asters formed in mitosis.

**Amphibian.** Starting life in water, finishing on land.

**Amphibiotic.** Cl. of vertebrate linking fishes and reptiles and including frog, newt, etc.

Amphibians, of which there are 1800 species (*q.v.*), are cold-blooded and oviparous, have a three-chambered heart, amphi-condylous vertebrae, hand-like limbs (which are transformed fins), no amnion. They breathe by gills in larval (tadpole) state, by lungs in adult.

**Amphibiotic.** Amphibian.

**Amphiblastic.** *App.* telolecithal ova (*q.v.*). **Amphicelous.** *App.* vertebrae concave at each end. *Cf.* Opisthocelous; Stereospondylous. **Amphigonium.** Archegonium.

**Amphigony.** Bisexual reproduction. Sporogony. **Amphimixis.** Blending of germ-plasm during cell-conjugation, and consequent mingling of character-bearing elements. *See* Apogamy. **Amphinucleus.** Nucleus with large karyosome and two haploid sets of chromosomes. A *kinetic*, enclosed within a *trophic*, nucleus.

**Amphiont.** Biont; sporont.

**Amphioxus.** Lancelet; lowest vertebrate.

Small, worm-like, marine creature tapering at each end possessing notochord, but without vertebrae, skull, kidneys, or red blood. Type of cephalochordata (*q.v.*) and sole representative of acrania (*q.v.*). An ancestral form (akin to *Larva* of modern tunicates) was probably the common forebear of all vertebrates.

**Amphipneust.** Breathing by gills and lungs. **Amphipods.**

Crustaceans, including sand-

hoppers. *Cf.* Isopoda. **Amphitene.** Meiosis stage when spireme threads unite in pairs.

**Amphitoky.** Production of m. and f. parthenogenetically.

**Amphitropal.** *App.* pl. embryo the apex and radicle of which point to hilum.

**Amphoteric.** Neutral—not acid nor alkaline. Capable of acting as acid or base. Capable of reacting electropositively or electronegatively.

**Amplectant.** Clasping tightly (tendrill). **Amplexicauline.** Stem-clasping.

**Amplitude.** Extent of oscillatory motion.

(1) In sound it is the distance within which mols. of air vibrate.

(2) In radiation it is the extent of to-and-fro vibration (of "ether" particles?) across line of wave-propagation. The intensity of light (or of heat) depends on a., but colour or quality depends on w.l. (3) A. of a pendulum is taken by some as distance from mean position to extreme, by others as distance between extremes. *Elec.* max. value of E.M.F. or of current during a half-cycle.

**Amylaceous.** Starchy.

**Amylase.** Enzyme accelerating hydrolysis of starch or glycogen. *Syn.* diastase.

**Amyloid.** *Per.* starch. Albuminoid derivative of cellulose.

**Amylolytic.** Capable of turning starch into sugar. **Amyloplast, -id.** Colourless, starch-forming body in pl.-cell. **Anaplast.** Leucoplast. **Amylose.** Group of carbohydrates ( $C_6H_{10}O_5$ )<sub>n</sub> from which pl. elaborates starch.

**Anabolism.** Integrative, constructive, energy-conserving ch. changes in protoplasm, changes wherein intake exceeds output and weight is gained. **Assimilative, syn-**

thetic metabolism. *Cf.* Katabolism.

**Anadromous.** Ascending rivers from sea. *Ex.* salmon. Having lowest nervures originating on upper side and near end of midrib (*Ferns*). *Opp.* catadromous.

**Anæmia.** Diminished no. of red blood cells. One cub. mm. of healthy blood contains 5 million red, and 8000 white cells; a cub. in. contains  $8 \times 10^{10}$  red,  $13 \times 10^7$  white cells.

**Anærobes.** Organisms (*ex.* bacteria) that, while breathing out  $\text{CO}_2$ , do not breathe in free O, and hence can thrive in medium devoid of this gas. *Cf.* *Ærobe*.

**Anæsthesia.** Loss of feeling.

**Anæsthetic.** Any drug (*e.g.*, chloroform) producing insensibility.

**Anakinetic.** Energy-resting. *Cf.* Katakinaetic.

**Analgesia.** Insensibility to pain.

**Analogy.** Structures morphologically dissimilar owing to unlike embryonic origin, but with similar physiological functions are *analogous organs*. *Ex.* wing of bird and wing of insect. *Cf.* Homologous.

**Analysis.** Resolution of a substance into its component parts—*e.g.*,  $\text{H}_2\text{O}$  into O and H; resolution of white light into component colours; elucidation of general principles underlying phenomena. *Opp.* synthesis.

**Anamnia.** Vertebrates (fishes, amphibians) destitute of amnion.

**Anamorph.** Larvæ deficient in segments. **Anamorphism, -osis.** Evolution from

simple to complex. Abnormal transformation in pl. Degeneration. Change of habit. *Gradual* *ev.* **Anamorphous.** Amorphous (*q.v.*).

**Anandrous.** Without stamens. **Ananthous.** Without inflorescence.

**Anaphase.** Third stage in mitosis when chromosomes split lengthwise. **Anaphylaxis.** Idiosyncrasy. Allergy. Excessive sensibility to cert. albuminoids in blood. **Anaplast, -id.** Tropho-, amyloplast (*q.v.*). **Anasarca.** Exudation of fluid between cells. **Dropsy.** **Anaschistic.** *App.* tetrads that split twice longitudinally during meiosis. Eumitotic. *Cf.* Diaschistic. **Anastes.** Materials formed during anabolism. *Cf.* Katastates.

**Anastomosis.** Intercommunication of nerves, vessels, tubes, etc.

**Anatrop-al, -ous, -y.** *Syn.* apotropy. **Inverted.** *App.* ovule with hilum and micropyle close together and chalaza at opp. end. *App.* also to ovule formed through a bending of nucellus so that one side of it is fused with the funiculus and micropyle is directed downwards. *Cf.* Orthotropous.

**Anchylosis.** Stiffened joint due to bony union. Tooth fused to jaw-bone. Synostosis.

**Androconia.** Wing-scales and connected perfume-glands in m. butterflies. **Androcyte.** Cell of androgonium that produces sperm-cell. **Auxocyte.** *See* Perenosome. **Androdiceious.** *App.* pl. with m. or hermaphrodite flowers only—*i.e.*, having staminate flowers only on one

pl., perfect flowers only on another. **Androscium**. All m. organs of pl. considered collectively; a group of microsporophylls. *See* Stamen. **Androgametangium**. Antheridium. **Androgametophore**. M. pl. **Androgenesis**. M. parthenogenesis. Development from ovum containing paternal chromosomes only. *Opp.* gynogenesis. **Androgonia**, -idia. Early stage of pl. sperms. M. cells resulting from repeated divs. of parthenogonidia. **Androgyn-al**, -ous. Hermaphrodite. Having staminate and pistillate flowers on same stem. **Androgynary**. Double flower with petaloid stamens and pistils. **Androgyne**. Hermaphrodite. **Andromonœcious**. Having m. and hermaphrodite (perfect) flowers on same pl. **Androphobia**. Morbid fear of m. sex. **Androphore**. Support of anther, andrœcium, m. organs, m. zooids, etc. **Androphyll**. Leaf-bearing microsporangium. Microsporophyll. **Androsporangium**. Sporangium containing **Androspores**. Cells producing antheridia. Asexually-produced zoospores (of algæ) from which arise dwarf-m. which in turn produce spermatozooids. **Microspores**.

**Anelectric**. Not readily electrified. Parting readily with electricity. *Opp.* dielectric. **Anelectrode**. Positive pole. **Anelectrotonus**. Decreased nerve-irritability near positive pole (anode) during passage of non-polarizing current. *Opp.* katelectrotonus. *See* Electrotonus. **Anemometer**. Instrument measuring force and

vel. of wind. **Anemone**. (1) An actinoid zoophyte. (2) A plant. **Anemophilous**. Wind-fertilized. **Anemo-taxis**, -tropism. Orientation to wind-direction. **Anencephaly**. Devoid of cranium.

**Aner**. Male, especially m. ant.

**Aneuploid**. *Per.* chromosome no. not a multiple of basic haploid no.

**Aneurism**. Abnormal dilatation of artery.

**Angiocarpous**. Having fruit enclosed in capsule other than calyx. **Angiomonospermous**. Having each seed enclosed in separate pod. **Angiosperm**. Flowering pl. with closed ovary—i.e., with ovules enclosed within megasporophylls (carpels). **Metasperm**. **Angiospore**. Pl. with encapsulated spores.

**Angle of incidence**. A. which a line—e.g., ray of light—makes with perpendicular to the surface at the point where it meets it. **A. of reflection**. A. which a line—e.g., ray of light—makes, after it leaves a surface, with the perpendicular to the surface at the point of departure. **A. of refraction**. The amount of deflection from original path suffered by a ray of light in passing *obliquely* from one medium into a different medium.

**Angström unit**.  $3.937 \times 10^{-8}$  in.  $1 \times 10^{-8}$  cm.  $1/10,000$  micron. 0.1 millimicron. W.l. of red cadmium line at  $15^{\circ}$  C. and 760 mm. P. = 6438.4696 international A.U.

**Anhydride**, *ch.* Compound formed from an acid by abstraction of water. An oxide devoid of H and absorbing

H on exposure to water to form an acid.

**Aniline.** Colourless, oily aromatic, coal-tar derivative.  $C_6H_5N$ .

**Animal.** Organism inspiring oxygen (as a gas or in solution), deriving carbon from oils, sugars, and fats of plants (or of other a.), nitrogen from compounds, not simpler than proteids, already built up by pl. (or other a.), destitute of chlorophyll, cellulose, and cell-walls, active, not fixed, great oxidizers and definitely katabolic.

A few animals are fixed by a stalk—some have cellulose and chlorophyll, but no a. can feed on inorganic materials, as can plants (*q.v.*). See Commensalism, Communism, Parasitism, Symbiosis.

**A. pole.** Embryogenic pole. The part of ovum opp. vegetative pole. See Telolecithal.

**Animikean.** Period of algonkian (proterozoic) underlying Keweenawan.

**Anion.** Negatively-charged ion which moves towards anode. Electronegative el. evolved at anode during electrolysis. *Opp. kation.*

**Anisocercal.** Lobes of tail-fin unequal. *Cf.* Homo-, hetero-, iso-cercal. **Anisogamete.** One of two markedly different-sized gametes; heterogamete (*q.v.*). **Anisogamy.** Syngamy (*q.v.*) in which conjugating gametes differ in form and size. **Anisospores.** Sexually dimorphic spores; spores in which m. spores are much smaller than f. spores. **Anisotrop-al, -ous, -y.** Condition of medium that is not homogeneous, whose properties are not the same in all

its parts, or which acts differently on polarized light, having power of turning rays right or left. *App.* eggs with predetermined axes. Responding differently to stimuli. Heterogeneous. **Æolotropic.** *Cf.* Isotropic.

**Anlage.** Foundation or "scaffolding" of embryo. Primitive elements out of which a cell, organ, or organism is formed. Blastema (*q.v.*).

**Annelids.** Segmented worms, including leeches. There are 4000 species (*q.v.*). **Annulata.** Ringed animals. **Ann-elida, -ulosa, -uloida.** **Annuloida.** Tapeworms and other ringed animals. **Annulosa.** Ringed animals of higher articulate group. *Annulata.*

**Anode.** Positive pole. Terminal electrode. Cell-valve. Photo-electric cell. Departure point of current. Area in conducting medium at which electrons or negative ions collect—i.e., finishing point of electron migration. Antikathode. *Cf.* Kathode. See S.L. **A. battery.** High-tension battery.

**Anodyne.** Drug that relieves pain.

**Ancestrus.** Non-mating period of sexual inactivity.

**Anomalistic.** *Per.* angular distance of planet from its perihelion. See Year.

**Anomodonts.** Fossil reptiles with no, or very irregular, teeth; they linked reptiles and mammals. Theromorphs. **Dicynodonts.**

**Anorexia.** Loss of appetite.

**Antagonist.** Muscle which counteracts or reciprocates an agonist (*q.v.*), contracting against its contraction, and so producing rigidity, or against

its relaxation, and so producing movement. *See* Antergism.

**Antambulacral.** Abactinal (*q.v.*).

**Antarctic.** Area N. of S. Pole  $23^{\circ} 28'$ , or S. of Lat.  $66^{\circ} 32'$ .

**Antennæ.** (1) Paired, jointed, sensory organs on head of insects, crustaceans, etc. "Feelers." Paired, irritable processes in cert. m. flowers which expel pollen. (2) Elevated aerials of wireless transmitting or receiving stations.

**Antergism.** Simultaneous contraction of opposing muscles. *Cf.* Synergism. *See* Antagonist.

**Anthelion.** Luminous ring projected on mist.

**Anther.** Part—usually summit—of stamens bearing pollen. It corresponds with antheridium (*q.v.*) in flowerless pl. Microsporangium. *See* Adnate, Ex-, In-torse, Stamen, Dorsiflexed, Sessile, Versatile. **Antheridiophore.** Gametophore bearing antheridia. **Antheridium.** Sperm-cells of cryptogams.

Organ (and receptacle) in ferns, mosses, algae, etc., in which motile spermatozooids are produced and stored. In ferns the a. is produced by gametophyte and lies on underside of prothallus; in lycopodiums it is produced by prothallial cell; in conifers the antheridial cell is homologous with the a. of pteridophytes and arises from a prothallial cell and produces the generative cell. The antheridium corresponds to anther (*q.v.*) of flowering pl.

**Antherozoid.** M. gamete of antheridia. Spermatozoid.

**Anthocarp.** Blended fruit and flower (pineapple), or multiple fruit (strawberry).

**Anthocyanin.** Bluish-violet pigment of flowers. **Anthogenesis.** Production by an asexual

aphid of both m. and f. **Anthophilous.** Pollen-collecting. Nectar-sucking. **Anthophore.** Stalk, above calyx, carrying petals and stamens. **Anthophyte.** Flowering pl. **Anthotaxis.** Position of flowers on axis. **Anthoxanthin.** Yellow pigment of flowers. **Anthozoa.** Actinozoa. **Anthozoid.** Individual of compound zoophyte.

**Anthracene.** Hydrocarbon derivative of coal-tar. **Anthracite.** Non-bituminous coal.

**Anthrax.** Disease (especially of wool-sorters) caused by *Bacillus anthracis*.

**Anthropism.** Making man the measure of all things and a pre-ordained end of some prior creation. *Syn.* anthropocentricism, -morphism. **Anthropocentricism.** Anthropism (*q.v.*). **Anthropogen-esis, -y.** Origin and development of man. **Anthropoid.** *Per.* man or ape. A man, ape-man, extinct or modern ape. *Ex.* gorilla; chimpanzee; orang; gibbon. **Pithecanthropus.** **Plio-, dryo-pithecus.** **Anthropology.** Science of mankind. **Anthropometry.** Study of human body-measurements. **Anthropomorphism.** Anthropism. **Anthropomorphs.** Tailless, man-like apes.

**Antibody.** Substance in blood which renders toxins, etc., innocuous. *Syn.* antitoxin. **Heterophil.** *Cf.* Antigen. **Anticathode.** Anode. Vacuum-tube target. **Anticlastic.** Doubly concavo-convex. Saddle-shaped. *Opp.* synclastic. **Anticlin-al, -e.** (1) *Geo.* A ridge wherein strata, having leant against one another, dip in opp. directions.

*Cf.* Synclinal. (2) *Zoo.* A line of div. of cells at right angles to apex. (3) *App.* vertebrae whose posterior spines incline on each side to a vertical central spine. **Anticryptic.** Protective coloration aiding *attack*. *See* Coloration. **Anticyclone.** Outward rotary airflow from zone of high pressure. **Antidrom-al, -ic, -ous.** Curving in opp. direction to normal. *Per.* spiral phyllotaxy with genetic spiral changing direction after each cycle. *Per.* vaso-dilatation caused by nervous impulses. *Opp.* homodromal. **Antigen.** Substance inducing formation of antibody (*q.v.*). **Antimony, ch. el.** Sb. Metal. *At. no.* 51; *at wt.* 121.76. **Antipyretic.** A substance that lowers body-temp. **Antisepsis.** Preventing multiplication of micro-organisms, especially pathogenic ones. **Antitoxin.** Antidote to toxin. **Antibody (*q.v.*).** **Antitrop-al, -ous, -y.** Inverted. Having radicle directed away from hilum. Repeated and reversed symmetrically. *Sinistrorse. Cf.* Syntropy. **Antrorse.** Bent forwards or upwards.

**Antrum.** Cavity, especially space in upper jaw.

**Anura.** Amphibians (frog) tailless as adults.

**Anus.** Posterior opening of alimentary canal. *See* Cloaca.

**Aorta.** Large artery proceeding leftwards from heart in mammals and rightwards in birds; in reptiles it is double and runs right and left.

**Apatetic.** Protective coloration for offence or defence.

**Ape fissure.** *See* Simian f. **A.-man.** Pithecanthropus.

**Aphasia.** Speechlessness.

**Aphelion.** Point in planet's orbit farthest from sun. Earth's position in early July. **Apsis.** **Ap-heliotropism.** Bending, or moving, away from a light-source. **Ahelio-, aphoto-tropism.** Negative heliotropism.

**Aphides.** Hemiptera (green-fly. Pl. lice).

**Aphonia.** Loss of capacity to make sounds.

**Aphototaxis.** Neutral reaction to light. **Aphototropism.** Apheliotropism (*q.v.*).

**Aphrodisiac.** Substance stimulating sex impulse.

**Apivorous.** Feeding on bees.

**Aplanatic.** Corrected for spherical aberration.

**Aplanogamete.** Non-motile gamete, m. or f., an. or pl. **Aplanoplastid.** Resting asexual spore. Spore formed through rejuvenescence of cell-contents. **Aplanospore.** **Aplanospore.** *See* Brood-cell.

**Apnoea.** Cessation of breathing.

**Apobiotic.** Diminution of protoplasmic vitality.

**Apocarpous.** Having separate or but partially united carpels. *Ex.* strawberry.

**Apocatastasis.** Renovation. Return to previous state, or to same apparent position during orbital revolution. **Apocyte.** Multinucleate cell. Mass of protoplasm resulting after *nuclear* (not cellular) division. Multinucleate mass of protoplasm following cell (not nuclear) fusion. **Coenocyte.** **Plasmodium.** **Apoda.** Various footless, finless, appendageless organisms. **Apodeme.** Inwardly-projecting body-wall processes for support of organs and attachment of muscles.

**Apogamy.** Alternation of generations (*q.v.*) in which archegonium, oosphere, and oospore stages on f. side, and antheridial and spermatozoal stages on m. side, are suppressed, while a gametophyte produces a sporophyte directly by budding. Parthenogenesis without intervention of specialized sex-cells, a "bud" taking place of fertilized egg. Inbreeding. **Apomixis.** *Cf.* Apospory; Amphimixis.

**Apogee.** Planet's or satellite's farthest distance from parent-body. Meridional altitude of sun on longest day. **Apsis.** *Cf.* Perigee. **Apogotropism, -y.** Turning or growing in a direction against gravity. Negative geotropism (*q.v.*). Ageotropism, -y. **Apogamy.** Selective breeding. **Apomixis.** Apogamy (*q.v.*). **Aponeurosis.** Expanded tendinous attachment of muscle. **Apophysis.** Bony prominence. Dilatation at base of spore-case in mosses. Protuberance on ovuliferous scale in conifers. Entothorax.

**Apoplexy.** Paralysis of motion, sensation, and thought due to hemorrhage in, or on, brain. Stroke.

**Aposematic.** Having warning or terrifying coloration, or repellent smell. *Ex.* skunk. *Cf.* Thanatosis. *See* Synaposematic. **Aposepalous.** Having free sepals. Polysepalous. **Aposporogony.** Suppressed sporogony.

**Apospory.** Alternation of generations (*q.v.*) in which sporophyte directly produces gametophyte (prothallus) by budding—*i.e.*, without spore-

formation and in absence of sporangia and asexual spores in life-cycle. *Ex.* fern; moss. *Cf.* Apogamy. A. involves replacement of spores by unspecialized cells which have not undergone meiosis. **Apothecium.** Ascocarp of lichens. Pelta. *See* Patella. **Apotropy.** Condition of erect ovule with raphe next placental axis. **Anatropy** (*q.v.*).

**Appalachian.** Part of Carboniferous period (Pennsylvanian-Permian).

**Appendicularians.** F. of small ascidian molluscs; free-swimming tadpole-like *Tunicates*. Larvacea.

**Apperception.** Perception in which an existing presentation is related to previously-acquired knowledge. Self-realization.

**Appleton layer.** Atmospheric layer (part of ionosphere) (*q.v.*). 150 miles above earth's surface. It reflects back to earth short wireless waves and facilitates long-distance transmission. *See* Kennelly.

**Apposition.** Growth by successive addition of particles to *outside*, as in growing crystal. Deposit of concentric layers of cellulose on inside of cell-wall in pl. *See* Accretion.

**Appulse.** Arrival of heavenly body at meridian. Act of conjunction of two heavenly bodies.

**Apsides, line of.** Straight line joining point of least distance of planet or satellite from parent body, to point of its greatest distance. **Apsis.** Pl. apsides. (1) Orbit of planet or satellite. (2) One of two points

in orbit at which revolving body is respectively at greatest or least distance from parent-body. *See* Ap-, peri-helion, apo-, peri-gee.

**Aptera.** Wingless arthropods. **Apteria.** Naked, or down-covered, surfaces between the pterylæ (*q.v.*). **Apteryx.** Flightless bird of New Zealand with very rudimentary wings. **Kiwi.**

**Arable.** Fit for cultivation.

**Arachnids.** Arthropods with 4 pairs of legs, chitinous exoskeleton, many with silk-spinning, and poison, glands. They are air-breathers except limulus (*q.v.*). They include spiders, mites, scorpions, and number 5000 species (*q.v.*). **Arachnidium.** Spinning-glands and spinnerets. **Arachnoid.** (1) *Per.* Arachnids. (2) Cobweb-like. Felted. **Araneous.** (3) Serous membrane enveloping brain and cord of mammals. (4) One of a cl. of arthropods including spiders, mites, scorpions. **Araneous.** **Arachnoid** (*q.v.*).

**Archæan.** Earliest geological period (or rocks). Metamorphosed, igneous rocks containing carbonaceous matter, remains, probably, of living matter, but *no fossils*. *See* Archæozoic.

**Archæocytes.** Undifferentiated, wandering cells—fore-runners of gametes. **Archæolithic.** Earliest stone age. **Archæopteryx.** Oldest known bird. A reptile-bird of upper Jurassic with biconcave (fish-like) vertebræ, sclerotic (reptile-like) eye-plates, a reptilian tail with a pair of feathers to each joint, three, free, reptile-like claws on each wing, separate pelvic bones,

and teeth in its jaws. **Archæozoic.** Era of earliest life preceding proterozoic, succeeding azoic. **Archæan.** **Palæolaurentian.** **Archebiosis.** **Abiogenesis** (*q.v.*). **Archegonium.** Female organ of reproduction in cryptogams corresponding with pistil in phanerogams.

It consists of external layers of sterile cells within which is a single large ovum. Within the *a.* the young plant commences its development, *ex. ovum*. In mosses, ferns, and liverworts the *a.* arises from a gametophyte and gives rise to the oosphere; in conifers the *a.* arises from endosperm and produces the oosphere; in ferns the *a.* is on under-side of prothallus. **Archisphere.** *See* Alternation.

**Archencephalon.** Primitive fore-brain. **Archenteron.** The gastrocoel, progaster, archenteric vesicle, or primitive gut. Cavity of gastrula. General space of yolk-sac, gut, and allantois which, closing up, becomes the alimentary canal (*q.v.*). *See* Primitive streak; Embryogenic pole.

**Arches, branchial and visceral.** In mammals and man these are relics of the water-breathing apparatus of an aquatic vert. ancestor the gills and gill-supports of whom they represent.

In the modern adult the *a.* are modified into Meckel's cartilage, parts of hyoid bone, tympano-hyal, thyroid, cricoid, arytenoid, and tracheal cartilages.

**Archosporium.** Group of cells that form pollen mother-cells. **Pansporoblast.** Spore of apocyte of myxosporidaceæ. Parent-cells of asexual spores of bryophytes. Capsular cells originating spore-mother-cells in liverworts. **Meristematic**



cells of young sporangium from which arise spore-mother-cells in ferns. See Epibasal.

**Archetype.** Original pattern from which modified descendants have arisen. Prototype. Original form, species, or group. Primitive, generalized, model. See Protentomon.

**Archiamphiasier.** Amphiasier that forms first, or second, polar body in cell maturation.

**Archiblast.** Primitive protoplasm. Germ-plasm. Epiblast. Primitive blastulation. Total and equal segmentation. **Archiblastula.** Typical hollow ball of cells arising from ovum with total and equal segmentation.

**Archicarp.** Female reproductive organ of ascomycetes which, fertilized, becomes the *ascogonium*, trichogyne plus ascogonium. Part of thallus of fungi. **Archichlamydeous.** Having no, or inter-separated, petals.

**Archicoel.** Primitive body-cavity between skin and gut. **Archi-genesis, -gony.** Abiogenesis (*q.v.*).

**Archimedes' Law.** (1) A body wholly or partly immersed in a fluid loses in wt. by an amount = that of fluid displaced. (2) Lever (*q.v.*).

**Archipallium.** Primitive ancient brain or that part of modern mammalian brain which represents it. Olfactory region of brain subserving smell sense, including *hippocampus*, *paraterminal body*, *pyriform lobe*, and *corpus striatum*.

**Archiplasm.** Undifferentiated protoplasm. Germ-plasm. Ergasto-, ergo-, kino-plasm. Cf. Trophoplasm. A. is "architectural" protoplasm

from which astral rays, spindle fibres, etc., in dividing egg-cell are formed. **Archipterygium.** Primitive type of fin-skeleton consisting of an elongated segmented axis with a row of jointed rays on each side. **Archisperm.** Gymnosperm. **Archisphere.** Unfertilized archegonium.

**Archi-, arco-centrous.** Having vertebral centra chiefly derived from neural- and hæmal-arch tissue. *Opp.* chordacentrous (*q.v.*).

**Arctic.** Area S. of N. Pole 23° 28'; or N. of Lat. 66° 32'. **Arctogæa.** Arctic, biologically considered. Cf. Notogæa.

**Area Opaca.** The dark area surrounding area pellucida. Germinative zone in egg within which embryo develops.

**Arenaceous.** Sandy desert.

**Areolar.** Containing spaces or areas. *Per.* fibro-elastic tissue.

**Argenteum.** Skin layer, on sides and belly of fishes, containing *iridocytes* (*q.v.*) and devoid of chromatophores and, on those accounts, having great light-reflecting power.

**Argillaceous.** Containing clay.

**Argon, ch. el. A.** Inert gas. *At. no.* 18; *at. wt.* 39.944. See Air.

**Aril, -lus.** Accessory seed-covering. An ex-placental outgrowth of funicle forming an extra coat to ovule. Mace.

**Arista.** Long, pointed process in grasses and corn. Awn. Bristle-like appendage of antenna.

**Armature.** (1) Piece of soft iron in contact with poles of magnet for preserving force. (2) Tin-foil coating of Leyden jar. (3) Piece of soft iron per-

mitting of magnetic force being introduced into electro-magnetic machine. (4) Part of dynamo-electric machine containing conductors which, when moved through a magnetic field, induces an elec. current. (5) Piece of soft iron vibrating in a magnetic field produced by a coil through which a *varying* current flows. (6) Defence, or offence, equipment of an. or pl. **Armo-genesis, -gony.** Adaptive embryonic development. *Cf.* Patrogony.

**Arrectores pilorum.** Tiny skin muscles that erect the hairs.

**Arrhenoplasm.** Male plasm. *See* Thelyplasm. **Arrhenotoky.** Parthenogenetic production of m. offspring by unimpregnated f. *Cf.* Deuterotoky.

**Arsenic, ch. el.** As. Metalloid. *At. no.* 33; *at. wt.* 74.910.

**Arsinoitherium.** Eocene, rhinoceros-like mammal.

**Artefact.** A humanly, as opp. naturally, made object. *Ez.* flint implement.

**Arterial sclerosis.** Hardened arteries due to calcium salts deposit. **Artery.** An elastic tube conveying blood *from* the heart.

**Artesian well.** Well supplied, through artificial boring, from water under high natural pressure.

**Arthritis.** Joint inflammation.

**Arthropods.** Bilaterally symmetrical, segmented, invertebrates with *jointed legs*, and chitinous or calcareous exoskeleton. Group of *articulata* including crabs, spiders, insects, and myriapods. **Arthrospore.** Thick-walled resting cell.

**Artiad.** *Ch. el.* of even valency. *Cf.* Perissad.

**Artificial selection.** Man's conscious selection of an. or pl. for breeding purposes as *cf.* c. Nature's unconscious selection.

**Artiodactyls.** Even-toed ungulates. *Cf.* Perissodactyls.

**Arundinaceous.** Reedy, reed-like.

**Aryan.** Parent tongue of Indo-European languages—Celtic, Greek, Latin, Persian, Sanskrit, Slavonic, Teutonic, and Zend. An original speaker of the parent-tongue. Caucasians, one branch of which entered Irania, another India.

**Arytænoid.** Pitcher-shaped. Cartilages and glands at back of larynx.

**Asbestos.** Fibrous hornblende. Magnesium-calcium silicate.

**Ascidians.** O. of chordates. Flask-shaped, tunicate, marine organisms, fixed in adult stage. **Ascidium.** Any flask-like organ or organism. Vasculum.

**Ascites.** Dropsy of peritoneum.

**Ascocarp.** Protective, cup-like covering investing asci and representing fructification. **Cleistocarp.** **Ascogonium.** Spirally-coiled organ from which asci arise. Sac-like structure in moulds and fungi in which gonads are formed. Fertilized part (middle binuclear cell), of archicarp (*q.v.*) containing asci and ascospores. *See* Ascus. **Ascoma.** Spore-case. **Ascomycetes.** *Cl.* of fungi including yeasts and moulds. **Ascospore.** Spore in ascus. **Ascus.** Sac-like cell (spore-sac) at end of hypha of fungi in which ascospores are

formed. Term app. both to spore-sac and binuclear cell within ascogonium (*q.v.*). See Ascocarp.

**Aseptic.** Devoid of living organisms or spores, or a reagent destroying these.

**Asexual.** Having no functional sex-organs. Sexless. *App.* parthenogenetic and vegetative (budding) reproduction. *App.* organism (*e.g.*, fern) that is neither m. nor f. and produces neither m. nor f. sex-cells, but does produce *reproducing* cells. *Syn.* agam-, -ic, -ous. **A. reproduction.** Production of offspring without cell-conjugation. Vegetative reproduction. Mono-, partheno-genesis; growth; cell-fission; budding (of hydra), "cuttings," runners, suckers, grafts, bulbils, regeneration, etc.

**Asphalt.** Bituminous substance native at Dead Sea, a complex of hydrocarbons—coal-tar, petroleum, etc.

**Asphyxia.** Suffocation from excess of CO<sub>2</sub> and want of O.

**Assimilation.** Process by which an an. or a pl. converts extraneous matter (food) into living matter (protoplasm). In pl. photosynthesis plus root-absorption. Anabolism. Constructive metabolism. *Cf.* Conjugation.

**Association.** Process whereby two or more brain-centres are temporarily connected. *App.* fibres connecting white matter in interior of brain with grey matter of cortex. Adherence of cells without cell-fusion. Fusion of cell-bodies without fusion of cell-nuclei. **A. areas** or centres. Portions of cerebral cortex between the sensory centres which provide path-

ways between the several centres so that "sense-impressions" may be retained and, in virtue of them, subsequent incoming impulses may be modified and final responses adjusted. The physical bases of *thought* and the highest representations of *sensation*.

**Astatic.** Having no tendency to take up a definite position. *Ex.* astatic magnetic needle which is neutral to earth's magnetism.

**Aster.** (1) Star-like achromatic mechanism composed of radiating chromosomes during mitosis. *Syn.* cytaster. *Cf.* Karyaster. (2) Any star-shaped organism. Star-fish. **Asteroid.** (1) (a) Star-shaped. (2) (n) One of some 1200 (Spencer Jones) minor planets between Mars and Jupiter. (3) (n) An echinoderm.

**Asthenia.** Weakness, diminution of vitality.

**Astigmatism.** Condition in which light-rays are not brought to a common focus on retina, thus causing blurred image and blurred vision.

**Astronomical unit.** Semi-major axis of earth's orbit; 92,800,000 miles. **Astrophysics.** Physics (and Chemistry) of heavenly bodies. **Astrosphere.** Aster less centrosome. Centrosphere.

**Asymptote.** A line which, while approaching nearer and nearer a given curve, never meets it within a finite distance.

**Atavism.** Reversion to earlier type. Resemblance to some ancestral form. Appearance of a structure normally latent and inherited from some remote ancestor.

called *chalones*. Chemical messengers.

**Autoblast.** An independent micro-organism. **Autocatalysis.** Cell-dissolution caused by a substance of its own elaboration. A process in which products formed during a chemical reaction themselves act as *catalysts* and alter the vel. of the reaction.

**Autochthon, -ous.** Aborigine or per. native of a country. Indigenous species.

**Autoclave.** Apparatus enabling the temp. of introduced substances to be raised well above the b.p. (100° C.) of water. **Autecious.** Autoicous (*q.v.*).

**Autogamy.** Self-fertilization. Fertilization by fusion of gametes derived from same parent-cell. *Cf.* Allo-, Cleisto-gamy. **Autogen-esis, -y.** Abiogenesis (*q.v.*). **Autogony** (*q.v.*). Term also app. to "spontaneous" reproduction or div. of *somatic* cells. Origin of organized from unorganized matter. *Cf.* Phylogenesis. **Autogenous.** Originating in same individual. **Autogony.** First phase of abiogenesis (*q.v.*), consisting in origin of primal protoplasm, *ex.* a formative solution. **Autogeny.** *Cf.* Plasmogony.

**Autogyro.** Heavier-than-air aircraft with *lifting* horizontal blades in addition to tractating vertical ones.

**Autoicous.** Autœcious. Living throughout life on one host. Having archegonia and antheridia on one pl. **Autointoxication.** Poisoning through absorption of toxins liberated by micro-organisms in alimentary canal. **Autolysis.** Digestion of parts of an organism by

other parts of itself—*e.g.*, disintegration of a cell by acids and ferments self-produced. **Automatism.** Action which at one time in life-history of an individual had been carried out by higher (volitional) nerve-centres, but which, owing to frequency with which the act has been performed, is later carried out "mechanically," —*i.e.*, without psychical interference by lower (sub-conscious) nerve-centres. Involuntary action. Action *apparently* spontaneous, but actually in response to unrecognizable stimuli. **Autonom-ic, -ous.** Self-governing. *App.* involuntary actions of sympathetic nervous system. **Autoparthenogenesis.** Development from unfertilized eggs through physicochemical stimuli. **Autophag-ous, -y.** Feeding on oneself as in hibernation and starvation. Also app. newly-hatched birds that can feed themselves. **Autophyllogeny.** Growth of one leaf out of another.

**Autophyt-e, -ic, -ism.** A pl. that obtains its food from inorganic world. *Cf.* Autotrophy; Hetero-, Sapro-phyte. **Autoplast.** Chloroplast. **Autopolyploid.** Polyploid (*q.v.*) with four identical chromosome sets. **Autosomes.** Chromosomes per. general somatic, non-sexual characters. **Euchromosomes.** *Cf.* Allosome. **Autosyndesis.** Pairing in autopolyploid of chromosomes from same parent. *Cf.* Allosyndesis. **Autotetraploid.** Didiploid. **Autotomy.** Self-mutilation—*e.g.*, reflex shedding of lizard's tail or crab's claw. **Autotroph-ism, -y.** Self-supporting. *App.* pl.

that is neither parasitic nor saprophytic, but lives solely on inorganic world. Holo-, autophytic. *Cf.* Autophyte. **Autotropism.** Growth in a straight line. **Autozoid.** Free individual zoid. *Cf.* Siphonozoid.

**Auxesis.** Restoration to normal size of cells that have become very minute through repeated cell-divisions. **Auxetics.** Ch. bodies that induce cell-division. **Auxocyte.** Gamete-forming cell. Gonotocent. Andro-, oo-, spermatoc-, sporo-cyte. **Auxospore.** Zygote formed by union of two cells at the limit of decrease of size. *See* Auxesis. **Auxotonic.** *See* Allassotonic.

**Aves.** Birds.

**Avicularium.** Snapping prehensile process (modified zoecium) in polyzoa. *See* Vibriaculum.

**Avitaminosis.** Vitamin deficiency. *Ex.* rickets, scurvy.

**Avogadro's law.** Equal vols. of gases contain equal no. of mols. provided t. and p. remain the same. **A.'s constant.** No. of mols. in a mole (*q.v.*) of a substance.  $6.0228 \times 10^{23}$  per gram-mol. *Syn.* A.'s number.

**Awn.** "Beard" or "bristle" of grasses.

**Axes of co-ordinates.** (1) (*Plane*). Two straight lines intersecting each other to which points are referred for the purpose of determining their relative positions. (2) (*Space*). Three straight lines in which the co-ordinate planes intersect each other. *See* Abscissa.

**Axil.** Upper angle between leaf or petiole and stem, or between trunk and branch. **Axilla.** Armpit.

**Axiom.** Self-evident proposition; law; established truth.

**Axis.** (1) Straight line passing through a body so that all parts are symmetrically disposed about it, or so that whole body could revolve equally about it. (2) **Axle.** Main stem, or root, or central cylinder, of pl. (3) Each of two intersecting straight lines, by reference to which the position of the *locus* is determined. (4) Imaginary line between centres of opp. faces, or edges, or apices of angles, of a crystal. (5) Straight line from object to eye. (6) Central column of inflorescence or of whorled shell. (7) Line joining N. and S. Poles. (8) Second vertebra. (9) Central skeleton or nervecord. (10) Hog-deer. **A. cylinder.** Chief process from a nerve-cell. Central, impulse-conveying tract of a medullated nerve-fibre. **Neuraxis.** **A. of abscissas.** *See* Abscissa. **A. of ecliptic.** D. of sphere passing through circle of ecliptic. **A. of equator.** Polar d. **A. of incidence.** Line passing through point of incidence perpendicular to surface. **A. of ordinates.** *See* Abscissa. **A. of refraction.** Continuation into refracting medium of a. of incidence (*q.v.*). **A., synclinal.** Line along which two opp. planes of stratification meet in a depression. **A. zone.** Episoma. **Axle.** Spindle around or with which a wheel or pair of wheels revolve.

**Axolotl.** Siredon. The gilled, larval, aquatic form of the American Salamander amblystoma. An amphibian which reproduces in the larval stage

when water is plentiful, but develops into a terrestrial amphibian and reproduces in that condition if water is scarce or if fed on thyroid (*q.v.*).

**Axon.** Main axis-cylinder (*q.v.*) outgrowth of nerve-cell. Neurite. The a. conveys impulses *away from* cell-body except in sensory neurones, when the impulses travel *into* the cell-body. **Axophyte.** Pl. possessing a stem.

**Azilian.** Stone Age following Magdalenian, preceding Neolithic.

**Azimuth.** Arc of heavens extending from zenith to horizon which it cuts at right angles. Quadrant of azimuth circle.

True a. of a star is the arc of the horizon intercepted between the N. point in northern hemisphere (or S.

point in southern hemisphere) of the horizon and the point where the great circle passing through the observed star cuts the horizon.

**A. circle.** Quadrant of a great circle of the sphere passing through the *zenith* and *nadir*. Angular distance of azimuth circle from a meridian. **A. magnetic.** Arc intercepted between magnetic meridian and great circle passing through observed star.

**Azotobacter.** Nitrogen-fixing bacterium.

**Azygosperm.** Spore that develops directly from a *single* gamete, i.e., without cell-conjugation, but which, as in case of zygosperm from two fused gametes, can nevertheless germinate and develop. **Azygosperm.** Partheno-sperm, -spore. **Azygosperm.** Azygosperm (*q.v.*).

## B

**Baboons.** African and Asiatic apes with large canines, cheek-pouches, and buttock-callosities.

**Bacilli.** Rod-shaped bacteria. Minute unicellular pl. which multiply by endospores and division.

**Backbone.** Vertebral column.

**Backfire.** An explosion in either intake or exhaust of a gas (petrol) engine; also a premature explosion (pinking) in cylinder.

**Bacteria.** Gen. of fission-fungi (*schizomycetes*). Minute unicellular pl. including bacilli, cocci, spirilla. **Bacteriophage.** An organism (*e.g.*, filter-passer) parasitic on bacteria. *Syn.* bacteriolysin. **Bacteroid.** Like a bacterium. A branched, de-

generate, or involuted bacterium.

**Baily's beads.** Chain of bright spots on limb of moon visible during total eclipse.

**Balanoglossus.** The acorn worm. Hemichorda. Enteropneust. A burrowing marine an. with vert. affinities.

**Baleen.** Whalebone (*q.v.*).

**Ballistics.** Science of projectiles in motion.

**Bamboo.** A woody, arborescent grass.

**Bantu.** Negroids of equatorial and S. Africa.

**Banyan.** An E. India tree (*Ficus*) which throws out aerial branches which, taking root, form additional trunks, thus enabling a single tree to cover thousands of sq. ft.

**Baobab.** Large African tree (30 ft. d.) with gourd-like fruit.

**Barb.** Element of a feather-vane. A hooked hair or bristle.

**Barbel.** A fish. A tactile organ on lips of fish. Barbule.

**Barbicle.** Process on a barbule.

**Barbituric acid.** Highly soporific crystalline salt,  $C_4H_4N_2O_3$ .

**Barbule.** Structure linking feather barbs. *Syn.* barbel.

**Barium, ch. el.** Ba. Metal. *At. no.* 56; *at. wt.* 137.36.

**Bark.** Tannin-containing tissues external to cork. Cortex. Cambium.

**Barm.** Yeast.

**Barnacles.** Cirrepedia. Crustaceans, free-swimming in larval, fixed in adult stage.

**Barograph.** Instrument recording atmospheric-pressure variations. **Barometer.** Instrument recording atmospheric pressure and hence for judging of state of weather or vertical distance of ascent or descent. Standard, sea-level pressure is a weight of atmosphere balancing 760 mm. or 29.92 ins. of mercury. **Barotaxy.** Geotaxy (*q.v.*).

**Barrows.** Mounds of earth or stones over the remains of prehistoric persons; the long mounds contain dolichocephalic, the round ones brachycephalic crania.

**Barysphere.** Hypothetical, 1700-mile-thick, solid, middle layer of earth internal to *lithosphere* but external to liquid core. It transmits earthquake waves.

**Baryta.** Barium monoxide.

**Basal ganglia.** Four masses of grey matter (brain-centres) below cerebral hemispheres.

**Basalt.** Igneous rock. **Base.** Compound that reacts with an acid to form a salt. A compound which, electrolyzed, yields hydroxyl ions. *Cf.* Acid. **Basement membrane.** A layer of single cells. **Basic.** *Per.* base. Alkaline. *Per.* a dye which owes its staining power to the base of a salt. Having excess of base-forming constituents. *App.* stains with avidity for nuclei. *Cf.* Acidic. **Basic number.** Supposed no. of chromosomes in gametes of a diploid ancestor of a polyploid.

**Basidiomycetes.** *Cl.* of fungi with septate hyphæ. **Basidiospores.** Conidia or spores of a basidium. **Basidium.** A conidiophore bearing basidiospores. **Basigamy.** Having position of oosphere reversed—*i.e.*, at lower, not upper end of embryo-sac. **Basilar membrane.** Membrane supporting organ. **Basipterygium.** Basal bone of paired fin. **Basophilic.** *App.* cells that stain readily with basic dyes.

**Bast.** Part of stem immediately external to cambium. Vascular bundles outside xylem. *Syn.* phloem.

**Batesian mimicry.** Protective resemblance of a palatable organism to a distasteful one.

**Bathic.** Bathysmal. **Bathmotropism.** Change in degree of excitability of heart muscle. **Bathometer.** Depth-measuring instrument. **Bathybius.** Inorganic gelatinous material in deep-sea mud. **Bathysmal.** Bathic. *Per.* depths or abyss.

**Batrachians.** Amphibians (frogs and toads).

**Battery.** Apparatus for de-

living electric current (primary or secondary cell) or electric discharge (Leyden jar) or for discharge of nematocysts.

**Beam transmission.** Emission of wireless waves in a specific direction by means of a reflector of arranged wires.

**Beat.** Periodic increase and decrease in volume of sound produced when two sounding bodies (*e.g.*, wires) emit tones not quite in unison. **B. frequency.** Frequency of b. wave. It is = numerical difference in frequencies of two interfering waves—*e.g.*, the united note from two wires giving 600 and 550 vibrations per sec. has a b. f. of 50.

**Bequerel rays.** Rays emitted by radioactive minerals—*e.g.*, salts of uranium.

**Beer's law.** The absorption of light by different concentrations of a solute is an exponential function of its concentration in the solvent, assuming a constant thickness of solution.

**Behaviour.** Acts of an organism, especially where consciously related to presence of other organisms. All behaviour is concluded in the synthesis and analysis of conditioned reflexes (*q.v.*). **Behaviourism.** Theory that psy. should use only observations and concepts pertaining to *behaviour* and should exclude all reference to feeling, imagination, and even thoughts, except where this is recognizable as implicit behaviour.

**Being.** Organism. Personality. Constitution. Essence. The substance or nature of an entity, also the entity itself. Existence. What has reality

or what may have reality—*i.e.*, what is logically conceivable.

**Bel.** (1) Wireless unit of power loss or gain.

(2) The Bel is a ratio signifying a 10-fold increase in intensity, power, or energy; 2 bels = 100-fold increase; 3 bels = 1000-fold increase; and so on. The range of human hearing is 13 bels or 130 *decibels*. A decibel represents (approx.) a  $\frac{1}{10}$  energy increase (or antilog  $1/10$ ); 2 decibels =  $(\frac{1}{10})^2$  increase, 3 decibels =  $(\frac{1}{10})^3$ ; 10 decibels =  $(\frac{1}{10})^{10}$ , *i.e.*, a 10-fold increase or one bel. Just as the decibel is the unit of *intensity*, the *phon* is the unit of *loudness*. The standard sound for reference has a freq. of 1000 cycles per sec. The zero point of loudness, at the threshold of hearing, is taken (Eng., Amer.) as corresponding to a *p.* of 0.0002 dyne per sq. cm. (Ger. 0.0003). Sixty phons is the loudness of ordinary speech while 130 phons represent the upper limit of loudness where sensation of hearing becomes that of pain. Each phon in the scale of 130 represents approx. the smallest difference of loudness distinguishable by the human ear.

**Belemnite.** The conical, calcareous, chambered, internal shell of an extinct cuttlefish.

**Benzene, benzol.**  $C_6H_6$ . Volatile, inflammable hydrocarbon.

**Beryllium, ch. el.** Be. Metal. *At. no.* 4; *at. wt.* 9.02.

**Beta particle.** A high-vel. electron (35,000–180,000 miles per sec.) ejected from nucleus of atom. **Beta ray.** A stream of beta particles.

**Betelgeuse.** A low-density, red, giant star. *d* = 350,000,000 miles.

**Bicipital.** With two heads or two parts.

**Bicron.** Millimicron (*q.v.*).

**Bicuspid.** Two-cusped tooth. Premolar.

**Biennial.** A pl. that lives two years, laying up food in the first, fruiting in the second year.



**Bifid.** Divided into two parts. **Bifurcate.** Forked. Having two branches. **Bigener.** A bigeneric hybrid. **Bijugate.** Having two pairs.

**Bile.** A viscid, yellowish-green, alkaline, digestive secretion of the liver. Gall. **Bilicyanin, -fucsin, -rubin, -verdin.** Pigments of bile and gall-stones.

**Billion.** 1,000,000,000,000 (Eng., Ger.). 1,000,000,000 (U.S., Fr.). See Index notation.

**Bilocular.** With two chambers.

**Binary.** Double. *Per.* compound of two els. or two radicals or of one el. and an equivalent radical. **Binary star.** Stellar system of two stars revolving about their centre of mass; they include *visual, spectroscopic,* and *eclipsing* binaries, and over 9000 have been catalogued. **Binomial.** *Per.* biological nomenclature in which a species receives *genus* and *species* title. An expression consisting of two terms connected by a + or - sign.

**Bioblast.** Biogen. Plasome. Cytoblast. Biophor (*q.v.*).

**Biochemistry.** Chemistry of living matter.

**Biocœnosis.** An interdependent association of different types of organisms acting as an ecological unit; a form of symbiosis. **Biogen.** Biophor (*q.v.*). **Biogenesis.** Biogeny. Ontogeny *plus* phylogeny. Evolution of organisms from pre-existent organisms. *Cf.* Abiogenesis. **B., law of.** Ontogeny briefly recapitulates phylogeny. Haeckel's law.

**Biology.** Science of living things. Zoology, botany, and

protistology. **Biometry.** Statistical study of organisms. **Bion.** The physiological individual. *Cf.* Morphon. **Bionomics, -nomy.** Science of laws of life and of relation between organism and environment. *Cf.* Ecology, Physiology. **Biontic.** *Per.* individual development. *Cf.* Phyletic. **Biophor.** Smallest particle of living matter. Supramolecular vital unit. Plasome. **Bioblast.** Id. **Idioblast.** Pangen. Determinant. **Biophysics.** Physics of life. **Bioplasma.** Germinal protoplasm. **Bioplast.** Primal living unit. Forebear of cell. **Plastidule.** **Bios.** *Per.* life. Vitamin necessary to growth of yeast and pl. shoots. **Biotaxy.** Taxonomy.

**Biot's law.** When an optically-active substance, or a magnetic field, rotates the plane of plane-polarized light, the angle of rotation varies inversely as the sq. of the w.l.

**Biparous.** Having two branches or axes. **Dichotomous.** Bearing two at a birth. **Bipenniform.** *App.* feather barbed on each side. **Bipinnate.** Having paired leaflets. **Bipinnatifid.** Having segments of pinnatifid leaf themselves segmented. **Bipinnatifid.** Twice pinnately parted. **Bipinnatisect.** Having divs. of a bipinnatifid leaf extending to midrib. **Biquadrate.** Sq. of a sq., or the fourth power. **Biradial.** Bilateral and radial. **Biradiate.** Two-rayed. **Biramous.** Two-branched.

**Birds.** Warm-blooded, feathered vertebrates with forelimbs modified for flight. They

evolved from reptiles. There are 20,000 species (*q.v.*).

**Bisexual.** *Per.* both sexes. Hermaphroditic. Amphigonic. Having both ovaries and testes or both androecium and gynoecium.

**Bismuth, ch. el.** Bi. Metal. *At. no.* 83; *at wt.* 209.00. Bi expands on solidifying, and of all metals it is the most non-conducting (of heat) and diamagnetic.

**Biting angle.** Smallest angle of impact at which a projectile can enter a body.

**Bitumen.** Asphalt, pitch, oils, tar, and other hydrocarbons.

**Bivalent.** *See* Valence. Chromatin rods representing two chromosomes united end to end. **Bivalve.** Mollusc with two hinged shells. *Ex.* oyster. Having two valves. *Ex.* diatom.

**Bladder.** Any membranous sac-like organ. Urinary bladder. Membranaceous pericarp. **Bladder-worm.** Larval tapeworm. *Cysticercus*. *Hydatid*.

**Blastæad.** Primitive multicellular organism resembling a blastula (*q.v.*). **Blastema.** Primal basis from which an organ grows. **Anlage.** **Blastid.** Forerunner of egg-nucleus. **Blastocele.** Segmentation cavity. **Blastula** cavity. **Blastoderm.**

**Blastocyst.** Germinal vesicle (*q.v.*). Simple cell-layer of blastula. Germinal disc. Cell-layer formed by div. of blastomeres, which differentiates into germinal layers that give rise to embryo. **Blastodermic vesicle.** Hollow sphere of cells formed during egg-segmenta-

tion. **Blastosphere.** **Blastula.** **Blastogenesis.** Reproduction by budding. Transmission of inherited characters through germ-plasm. Having an origin and differentiation within the gametes. **Ontogenesis.** *Cf.* Trophogenesis. **Blastomeres.** First few cells formed by div. of zygote. **Blastoderm** cell. **Protoblast.** **Blastopore.** Primitive mouth leading to archenteron. Aperture or mouth of gastrula. **Blastosphere.** **Blastodermic vesicle.** **Blastula** (*q.v.*). **Blastostyle.** Reproductive zooid without mouth or tentacles. **Gonoblastid.** **Gonostyle.** **Blastozooid.** Zooid produced by gemmation. *Cf.* Oozooid. **Blastula.** Single-cell-layered sac (without opening), representing early embryo. **Blastosphere.** **Blastodermic vesicle** (*q.v.*).

**Blattnerphone.** Apparatus recording sounds on a steel tape, which sounds can be subsequently reproduced.

**Blepharoplast.** A protoplasmic body in spermatid related to development of flagellum of spermatozooid. **Centriole.** **Centrosome.** **Kinetonucleus.**

**Blight.** Withering of pl. due to parasitic bacteria, fungi, or insects, especially aphides.

**Blind spot.** Point in retina where optic nerve passes through it.

**Blood.** Fluid circulating through an. vascular system carrying O and food to, and waste products from, each cell. *See* *Hæmatoblast*; *Hæmoglobin*; *Plasmocyte*.

B. consists of a liquid, *plasma*, in which are suspended disc-shaped red *b. corpuscles* and nucleated white *b.*

**cells** or leucocytes. Outside the vessels *b. coagulates* into a fibrinous clot from which oozes a liquid *serum*. The r.b.-c. in man are 0.0079 mm., or 1/3200 in. d., and there are five million to a cub. mm., as *cf. c.* about 8000 w.b.-c. per cub. mm. In man the b. is 4.9 p.c. of his body-weight—*i.e.*, about 6 pints of blood.

**B.-rain.** Moisture deposited on bodies, and coloured red by various organisms—*e.g.*, *Bacillus prodigiosus*. See Red snow. **B.-group.** Four types into which *b.* is classified according to its compatibility with the *b.* of other individuals. Transfusion of incompatible *b.* may result in dangerous hæmolysis and cell-clumping.

**Blow-fly.** Various species of flies that lay eggs (or larvæ) on meat or in wounds. Blue-bottle. **B.-hole.** Nostril of cetaceans; there are two in whalebone, one in toothed whales.

**Blue baby.** Infant with cyanosis due to patent foramen in inter-auricular septum.

**B.-bottle.** Blow-fly (*q.v.*).

**Body.** Total organized material of a single an. or pl. A form of matter. A material substance. **B. cavity.** Space between body-wall and digestive tube. Cælom.

**Boiling.** Generation, by heat or diminution of pressure, of bubbles of vapour in a liquid. Ebullition. *Cf.* Evaporation. **B. point.** Temp. at which a liquid emits bubbles of vapour. At sea-level the b.p. of hydrogen is — 252.7° C.; of oxygen is — 183° C.; of chlorine is — 34.6° C.; of ether, 35° C.; of alcohol, 78.32° C.; of water, 100° C.; of mercury, 357.22° C.; of zinc, 907° C.; of platinum, 4300° C.

**Bolide.** A meteor. **Bolometer.** Instrument for measuring minute quantities of radiant heat by observing changes in elec. resistance of a very thin platinum wire; it registers 1/1,000,000 of a deg. C.

**Bone.** Dense tissue of vert. skeleton consisting of a gelatinous matrix hardened by salts, especially calcium phosphate.

**Bonellia.** Genus of marine worms the m. of which are very much reduced in size and live parasitically within the nephridium of the f. See Sex.

**Borax.** Sodium tetraborate,  $\text{Na}_2\text{B}_4\text{O}_7$ .

**Bore.** (1) A cylindrical cavity; also its diameter. (2) A rapid tidal flood with steep wave-front which rushes up certain rivers.

**Bornite.** Sulphide of copper and iron,  $\text{Cu}_5\text{FeS}_4$ , the crystals of which are used as a detector of wireless messages.

**Boron, ch. el. B.** Non-metal. *At. no.* 5; *at. wt.* 10.82.

**Botany.** Science of plants.

**Botulism.** Poisoning by toxins of anærobic bacilli (*Bacillus botulinus*).

**B.O.T. unit.** Board of Trade unit. *Ex.* that of electric power is one kilowatt-hour.

**Bovidae.** Fam. of ruminants, including true antelopes (*not* deer), goat, sheep, oxen.

**Brachial.** *Per.* arm or arm-like process. **Brachiopods.** Marine (often stalked) molluscs with bivalve shells. **Brachisto-, brachy-cephalic.** *App.* short, and broad, heads, the breadth of which is at least  $\frac{1}{2}$  the length. See Index, cephalic; Dolichocephaly.

**Bract.** Part of leaf-axil from which arises the flower or

floral axis. Leaf borne on the floral axis. Specialized leaf associated with sexual organs in mosses. Glume. Spathe. Bractlet. Bracteole. Leaf-like part of limb of crustacean. Phyllopodium. Hydrophyllium.

**Brain.** That part of nervous system at anterior end of nerve-cord which is constructed upon and evolved from distance receptor organs.

Large mass of nerve-tissue within cranium of vertebrates or at fore end of invertebrates. Organ subserving sensation and thought. Organ of mind. The great mass of nerve-cells the functioning of which is the mind. The b. is composed externally of grey matter, the neurons; internally, of white matter, the nerve-fibres. It is div. into three parts: (1) The fore-b. or prosencephalon, subdivided into (a) the end-b., or telencephalon, which includes the two cerebral hemispheres connected together by the corpus callosum, and (b) the diencephalon or between-b. including the thalamus. The grey matter or cortex, together with underlying white matter of the cerebral hemispheres, is puckered into elevations and depressions, the former being the convolutions. The grey matter consists of two parts: the archipallium, phylogenetically the older part, pertaining to olfactory sense, and the neopallium, phylogenetically recent and enormously developed in man, and pertaining to visual, auditory, and higher psychic processes. (2) The mid-b. or mesencephalon includes the optic lobes; (3) the hind-b. or rhombencephalon is further div. into the metencephalon, which includes the cerebellum and pons, and the after-b. or myelencephalon, which includes the medulla oblongata, which receives the upper end of the spinal cord. The b. is about 85 p.c. water, and contains some  $1.2 \times 10^{10}$  nerve-cells. Wt. varies according to size and type of an. Brontosaurus, e.g., weighing 37 tons, had a 2 lb. b.—i.e.,  $\frac{1}{2}$  grain to each lb. of body. Gorilla has 31 grains, man 145 grains, respectively to govern each lb. of body. The b. of an average European weighs 48½ ozs. (1375 grams). Helmholtz's brain was

45 ozs. (1276 g.); Abercrombie's 63 ozs. (1786 g.), while Cuvier's was 64 ozs. or 1814 g. *Syn.* encephalon. Supra-oesophageal ganglion (invertebrates). *See* Cerebrum; Convolutions; *Corpora quadrigemina.*

**Branchiæ.** Respiratory organs of water-breathing an. Gills. Ctenidia. Podo-, arthro-, pleuro-branchiæ.

**Branchial arches.** Bony or gristly arches in throat-wall which support the gill-bars of fishes. They are present as rudiments in human embryo. *Syn.* gill-arches. *See* Arches.

**B. clefts.** A series of 6 to 7 pairs of apertures in wall of throat of fishes (and amphibians) by which the throat freely communicates with the exterior. Present as rudiments in human embryo. Gill, or visceral, clefts. *See* Gill.

**B. pouches.** Respiratory adjuncts to b. clefts. A type of gill-slits (q.v.). **B. sac.** Mouth-pharynx of ascidians; it is pierced by clefts. **Branchiomere.** Segment that forms b. arch. **Branchiopoda.** Primitive aquatic crustaceans with numerous leaf-like limbs. **Branchiostege.** Gill-cover, **Branchiostegite.** Part of wall of gill-chamber of crustaceans.

**Brass.** Alloy of copper and zinc; usually 2 Cu to 1 Zn.

**Breadfruit.** Fruit of a Polynesian tree, *Artocarpus*.

**Breathing pore.** Any small aperture giving access to O for respiratory purposes. Orifice connecting interior of liverwort thallus with the air. *Syn.* stoma, stigma. **B. valves.** Mucous membrane folds in fishes' mouths which control course of expiratory water flow.

**Breech.** (1) Buttocks. (2) Rear part of gun.

**Breed.** *v.* to propagate; to beget offspring, to conjugate, to pollinate. *n.* race variety. A group more extensive than a *strain* (*q.v.*).

**Bregma.** Area on head where frontals and parietals meet.

**Brephic.** *App.* early, primitive, or larval growth. Neanic.

**Brevipennate.** Having short, or useless, wings.

**Brewster's law.** When light reflected from plane surface of a transparent substance is plane-polarized, the tangent of the angle of incidence is = the index of refraction of the substance.

**Britannia metal.** Alloy of tin, antimony, and copper, sometimes with zinc and bismuth added.

**British thermal unit.** *B.Th.U.* Heat that will raise temp. of 1 lb. of water at max. density (39.1° F.) 1 deg. F. It = 0.252 large Cal. or 252.0 small cal.

**Brittle stars.** Ophiuroid echinoderms.

**Bromatia.** Swellings on a fungus cultivated by ants, serving as food.

**Bromide.** Binary compound of bromine. Bromides (*e.g.*, KBr) are cerebral sedatives and also retard "developing agents" in photography. **Bromine**, *ch. el.* Br. Halogen. *At. no.* 35; *at. wt.* 79.916.

**Bronchi.** Branching tubes connecting wind-pipe and lungs.

**Brontosaurus.** Jurassic dinosaur. *See* Brain.

**Bronze.** Hard, sonorous alloy of copper and tin, sometimes with zinc and phosphorus added. **B. age.** Period c. 2000 B.C. following Carnacian, followed by iron age.

**Brood bud.** Bulbil. Soredium. **B. cells.** A group of minute, rapidly-formed, daughter-cells of a b.-mother-cell. Spores. Gonidia (*q.v.*). If very motile, zoospores; if ciliated, flagellulæ; if sluggish, amœbulæ; if motionless, aplanospores. Asexual reproductive cells on gametophyte (*q.v.*). *Cf.* Merozoite. *See* Sporulation. **B. chamber.** **B. pouch.** Any space in which ova or young are housed and nurtured. *Ex.* ventral fin of fish *Solenostoma*, abdominal pouch of sea-horse, mouth and throat of *Arius*, capsule of hydroids, coelom of sea-urchin, skin recess of sea-cucumber and midwife toad, tentacles of worms, depression on back of water-fleas, abdominal surface and overlapping thoracic limb-plates of crustaceans, gill-cavities of bivalves, brood-shell of argonaut.

**Broom-rape.** Various root-parasitic plants. *Ex. orobanchaceæ.*

**Brownian movement.** Rapid random vibratory motion communicated by invisible mols. to minute particles suspended in a liquid.

**Brünn race.** Prehistoric (Solutrean) central European dolichocephalic race with skull smaller than modern races.

**Brush discharge.** Escape of electrons from high-potential conductors with production of luminosity. St. Elmo's fire.

**Bryology.** Study of mosses. **Bryophytes.** Moss-plants. Group of acotyledonous plants with alternating generations (*q.v.*) which are linked to pteridophytes on one, to

thallophytes, on other side. Includes mosses and liverworts. Bryozoa. Molluscoidea. Moss-like marine an., single and colonial, usually in chitinous tubes. Polyzoa. Sea-mosses.

**Buccal.** *Per.* mouth and cheeks.

**Bud.** An undeveloped, incipient, leaf, flower, shoot, branch, or stem. Swelling in an an. which grows into a new an. and detaches itself. Vegetative cell outgrowth, *e.g.*, yeast. *Syn.* gemma. **B.**, adventitious. **B.** that arises from abnormal part—*i.e.*, not from stem-apex or axil of leaf. **B.**, apical. **B.** formed at end of stem or branch. Terminal **b.** **B.**, axillary. **B.** arising in leaf-axil. **Budding.** (1) Insertion of *scion* (*q.v.*) beneath bark of *stock* (*q.v.*) so that cambium of former contacts with wood of stock. Grafting. (2) A form of reproduction in which a part of a cell detaches itself and grows independently. Pullulation. Blastogenesis (*q.v.*).

**Buffer salts.** Salts—*e.g.*, Sod. carb. and bicarb.—which tend to keep a watery solution neutral by counterbalancing hydrogen (H) ions and so checking acidity, and hydroxyl (HO) ions, and so checking alkalinity.

**Bulb.** (1) Resting, food-storing stage of a pl. represented by a specialized, usually underground, bud, throwing out roots below and bearing several overlapping, fleshy, scale-like leaves above. A fleshy tuber. *Cf.* *Corm.* A *rhizocorm*. (2) Any rounded mass. (3) The medulla oblongata. (4) A palpal organ.

(5) Incandescent electric lamp. **Bulbil.** A fleshy, axillary bud which falls off and grows into new pl. *Ex.* tiger-lily. An aerial bulb. Brood-bud.

**Bullate.** Blistered, puckered, inflated.

**Bullock.** Castrated bull.

**Bundle.** *See* Vascular.

**Bunodont.** Earliest type of molars (grinding teeth) with tubercles on their crowns. *Cf.* Lophodont.

**Bunsen burner.** Type of gas-burner with holes at base of delivery tube through which air enters forming a gas mixture that burns with an intensely hot, non-luminous, flame.

**Bursa.** Sac-like space filled with a viscid fluid, the whole acting as a pressure or friction pad. **B. copulatrix.** Clasper of m. nematodes and other an. Chamber in f. lepidoptera in connection with seminal duct and oviduct. *Syn.* spermatheca (*q.v.*). Genital pouch. **B. seminalis.** Receptacle for spermatozoa appended to genital canal of worms, and at base of arms of ophiurians. **Bursicule.** Any small pouch.

**Bushel.** Standard British: 36.3677 litres, 2219.36 cub. ins., 80.00 lbs. of distilled water at 62° F. Standard American: 35.2385 litres, or space occupied by 77.6274 lbs. distilled water at 39.2° F.

**Byssus.** A tuft of viscous threads secreted by **B. gland** which harden to tough filaments on contact with water and by means of which mussels attach themselves to objects, or their *glochidium* larvæ fix themselves to fishes.

## C

**Cachexia.** Malnutrition. Loss of vitality. **Cacogenesis.** Deterioration of race or stock. **Dysgenesis.**

**Cadmium**, *ch. el.* Cd. Metal. *At. no.* 48; *at. wt.* 112.410. **C. line.** Red radiation from c.-vapour lamp at 15° C. 760 mm. p. used as wave-length unit. It = 6438-4696 A.U. or  $6.438 \times 10^{-5}$  cm.

**Cadophore.** Bud-supporting organ in tunicates. Stolon.

**Caducibranchiate.** Shedding (larval) gills in later life. **Caducous.** Falling off early (e.g., calyx). Deciduous.

**Cæcum.** Blind sac at junction of small and large intestine into which appendix opens. Diverticulum of gut of birds and insects.

**Cænogæa.** Ne-, palæ-arctic, and Oriental regions. *Cf.* **Eogæa.** **Cænogenesis.** Omision in development of embryo of certain ancestral characters combined with introduction of non-primitive characters in consequence of secondary adaptation to special conditions of uterine environment. In c. past stages of the palinogenetic record are left out, while new stages, with no precise parallel in ancestry, are introduced. *Ex.* placenta of mammals. *Cf.* **Palin-**, **tachy-**genesis. **Cænozoic.** Age of mammals and birds. End of Mesozoic to present day. Tertiary plus Quaternary.

**Cæsarian section.** Removal of child through uterine and abdominal walls.

**Cæsium**, *ch. el.* Cs. Metal. *At. no.* 55; *at. wt.* 132.91.

**Caffeine.** Alkaloid in coffee.  $C_8H_{10}N_4O_2$ .

**Cainozoic.** Tertiary period. **Caisson disease.** Formation of gas bubbles in blood due to too rapid decompression following compression during diving operations.

**Calamine.** Zinc carbonate; also hydrous zinc silicate.

**Calamus.** Quill. Part of brain. Species of palm.

**Calcaneu-m, -s.** Heel-bone. *Os calcis.* Metatarsal process of birds. Hypotarsus.

**Calcicolous.** Living in chalky soil. *Per.* calci-cole, -pete, or gypsophyte. **Calciferous.** Containing or producing lime or chalk. **Calcigerous.** **Calcification.** Deposition of lime salts in tissues. **Calcifuge.** Silicole. Organism *not* thriving in chalky soil. **Calcigerous.** **Calciferous.** **Calcination.** Reduction to powder by heat. **Calcipete.** *See* **Calcicolous.** **Calcite.** Calc-spar. Hexagonal carbonate of lime. **Calcium**, *ch. el.* Ca. Metal. *At. no.* 20; *at. wt.* 40.08. **Calc-spar.** **Calcite.** **Calcivorous.** Growing on limestone. **Calculus.** Limy concretion—e.g., "stone" in bladder or gall-bladder—in an organ. Branch of mathematics.

**Calicole.** Gypsophyte (*q.v.*). **Caliper.** Instrument for measuring diameter of an object.

**Callose.** Hard material of cell-wall, more insoluble than cellulose. **Callosity.** State of being **Callous**, hardened, indurated, horny. **Callus.** New bony tissue. Tissue that forms over wounds (an. or pl.) or

damaged parts. Shelly material.

**Calomel.** Mercurous chloride.  $\text{HgCl}$ .

**Calorescence.** Transformation of dark heat-rays into luminous rays. **Calorie.** (1) *Small calorie* is heat required at normal p. to raise temp. of 1 gramme (or c.c.) of water from  $0^{\circ}\text{C}$ . to  $1^{\circ}\text{C}$ . It varies with temp., thus  $0-1^{\circ}\text{C} = 1.000$ ;  $4-5^{\circ}\text{C} = 0.998$ ;  $15-16^{\circ}\text{C} = 0.992$ . (2) *Great Calorie.* *Kilocalorie.* *Food-calorie*, is heat required to raise temp. of 1000 grammes (or 1000 c.c.) or 1 kilogramme of water from  $0^{\circ}\text{C}$ . to  $1^{\circ}\text{C}$ , i.e., it = 1000 small calories.

An average man requires an intake of 3500-3525 food-calories daily; in bed about 2000 suffices. Proteins yield 4.1 large Cals. per gramme; carbohydrates, 4.1, fats 9.3, alcohol 7.0. This means that 1 gramme of protein, or of sugar, or of fat, or of alcohol, if completely burned in a calorimeter or completely oxidized in the living tissues, yields energy (in the body represented as work done by organs) eq. to raising the temp. of a kilogramme (1000 grammes) of water  $4.1^{\circ}\text{C}$ .,  $4.1^{\circ}\text{C}$ .,  $9.3^{\circ}\text{C}$ . and  $7.0^{\circ}\text{C}$ ., respectively, and hence the Calorie value of protein is 4.1; of sugar, 4.1; of fat, 9.3; and of alcohol, 7.0. A 6-ft., 14-stone navvy doing hard work requires about 3700 Cals.; a 5½-ft., 11-stone clerk leading a sedentary life needs only about 2600 Cals. An average diet is: breakfast, 1050; lunch, 950; tea 200; dinner, 1250. One great Cal. = 3.968 B.Th.U. or 1 B.Th.U. = 0.252 great Cal. A *Rational Calorie* or *centuple* = heat required to raise 1 gramme of water from  $0^{\circ}\text{C}$ . to  $100^{\circ}\text{C}$ . A *Mean Calorie* is 1/100th part of rational Cal.

**Calorimeter.** Instrument for measuring quantities of heat.

**Calthrop.** A many-pointed structure. Sponge-spicule. Spiny fruit. Tetraet. Also

**Caltrop.**

**Calvari-a, -um.** Dome of skull.

**Calycanthemy.** Abnormal transformation of flower parts, calyx into petals, etc. Excessive petalody. **Calycifloræ.** Flowers with stamens and petals inserted on calyx or disc. **Calyciform.** Cup-shaped. **Calycle.** Cup-like organ—e.g., in corals and hydroids. **Epicalyx.** Taste-bud. Cell. **Calypptoblastic.** App. hydroids with gonophores enclosed in gonotheca. **Calypptobranchiate.** Having covered gills. **Calypptosis.** Arthropod larva with short-stalked eyes. **Calyptra.** Root-cap. Cap-like cover—e.g., archegonium of liverworts and mosses. **Calypptrogen.** Apical cell-layer from which root-cap arises. **Calyx.** Outermost whorl of flower-parts (usually green) made up of sepals, leaves specialized to protect inner flower-whorls. Cup-like part of kidney, also of body of crinoids; theca of hydroids.

**Cambium.** Soft, single-celled, formative layer of stem between the internal wood or xylem and the external phloem or bast. Persistent meristematic tissue of root and stem. By its growth, the thickness of the wood and bast is increased. C. is absent in monocotyledons. *Cork c.* is phellogen.

**Cambrian.** Earliest div. of Palæozoic rocks underlying, in Wales, the Silurian. In America it lies above Keweenaw and below Ordovician.

**Cameration.** Div. into separate compartments.

**Campaniform, -ulate.** Bell-shaped.

**Camphor.** Crystalline ex-



tract of camphor-tree and laurel.  $C_{10}H_{16}O$ .

**Campodea.** An eyeless, generalized type of insect; probably nearest in structure to common ancestor of all insects.

**Campylosporous.** Having seeds grooved on inner face.

**Campylotropous.** *App.* ovule with nucellus and embryo-sac so curved as to point micropyle towards placenta.

**Canal rays.** *Positively-charged* particles consisting of atoms from which electrons have been expelled. In a vacuum-tube they rush towards, and then through, a *canalized* kathode. They are deflected in a magnetic field in a direction opp. to that taken by kathode rays, or negative electrons. *See* Recoil radiations.

**Cancell-ate, -ous.** Having slender space-enclosing partitions as in head of bones. Spongy. Reticulated.

**Cancer.** An abnormal assemblage of cells which grows "malignantly" at expense of normal body-cells. Epithelioma. Carcinoma.

**Candle.** Unit of luminous intensity, a specified fraction of average candle-power of a group of 45 standard carbon-filament lamps. **C.-power;** **spherical.** The average c.-p. of lamp in *all* directions. It = total luminous flux of lamp in lumens div. by  $4\pi$ ; the *lumen* or unit of flux being the flux emitted in unit solid angle by a point-source of one-candle luminous intensity. A uniform point-source of one-candle intensity emits  $4\pi$  lumens. **C.-metre.** Illumination produced by a one international candle-

power source held normal to, and one metre from, a small element of area; one candle-metre = one *lux* or one *lumen* per sq. metre or 0.0929 foot-candle. Comfortable reading is 30 c.-m. **C.-foot.** Intensity of illumination of a standard candle at 1 ft. Comfortable reading is 3-ft. candles.

**Canine tooth.** The sharp-pointed tooth between incisors and bicuspids.

**Canker.** Any lesion or ulceration, as that caused by **C.** worm in pl., or by micro-organisms in ear or foot.

**Cannon bone.** Metacarpal or metatarsal of third digit of horse, etc. Tarso-metatarsus of birds.

**Canthus.** Either angle where upper and lower eyelids meet.

**Cap cells.** Cells closing neck of archegonium.

**Capac-itanee, -ity.** Quantity of electricity with which an isolated conductor can be charged. Ratio of charge on a conductor to its potential. Quantity of deliverable electricity under given conditions. Power of surface atoms of a conductor to lose or gain planetary electrons—a power definitely limited since an atom can gain or lose only a limited no. of electrons. **C. unit.** Conductor on which unit charge can be placed with the expenditure of one erg of work. A sphere 1 cm. radius in air has cap. = 1 e.s.u. (1 e.s.u. =  $1/9 \times 10^{-11}$  farads; 1 e.m.u. =  $10^9$  farads). The practical c.u. is the farad or a c. such that a charge of 1 coulomb raises the potential to 1 volt. Another practical unit is the microfarad or  $10^{-6}$  farad. One

farad =  $10^6$  microfarads or =  $9 \times 10^{11}$  e.s.u. of C.

**Capillary.** Hair-like. One of the minute blood-vessels that connect the small arteries and veins and that form a network all over body. They average 0.02 in. in length and 0.0003 in. in d. **C. attraction and repulsion.** **Capillarity.** A phenomenon consisting in the ascent or descent of liquids in tubes of *hair-like* calibre and depending on relative attraction of mols. of liquid for each other and for those of the solid glass. Liquids that *wet* glass ascend—e.g., water. Liquids that do not, descend—e.g., mercury. See Surface tension.

**Capillitium.** Protoplasmic network among which spores are distributed in sporangium of fungi.

**Capit-ellum, -ulum.** Tentacle-carrying part of polyp. Rounded bone-articulation; *ex.* head of rib. Rounded "head" of sessile flowers; *ex.* daisy. Any knob-like process.

**Capreolate.** Having tendrils.

**Capsule.** (1) Sac-like structure—e.g., of a joint. (2) Spore- or seed-case. (3) Part of brain.

**Carapace.** Dorsal shield of chelonia. *Cf.* Plastron. Chitinous or bony dorsal shield. Shell enveloping ant. part of crustacean body. Shell-like parts of cirripedes.

**Carbamide.** Urea (*q.v.*).

**Carbohydrate.** Compound containing carbon, together with hydrogen and oxygen, in proportions to form water (HHO). *Ex.* starch, cellulose, inulin, each  $C_6H_{10}O_5$ ; grape-

sugar,  $C_6H_{12}O_6$ ; cane- and malt-sugar, each  $C_{12}H_{22}O_{11}$ . Important constituent of foods, thus: sugar, 100 p.c.; peas, 61.7 p.c.; bread (white) 52.3 p.c.; potatoes, 20.1 p.c.; milk, 4.8 p.c. **Carbon, *ch. el.*** **C.** Non-metal. Diamond, graphite, charcoal. *At. no.* 6; *at. wt.* 12.00. **C. dioxide.** Heavy, colourless gas. Carbonic acid gas.  $CO_2$ . Produced during combustion of organic matter. **C. monoxide.** Light, colourless, inflammable, poisonous gas.  $CO$ . Produced during *imperfect* combustion of organic matter. **Carboniferous.** *Geo.* div. between Devonian below and Permian above. Corresponds to American Pennsylvanian plus Mississippian. **Carbophilous.** Attracted by or readily adsorbed by C. *App.* nitrogen-assimilating micro-organisms that feed on organic C compounds. *Syn.* philocarbonic. *Cf.* Sulphophilous. **Carburettor.** Apparatus for mixing explosive gas with air.

**Carcinoma.** Cancer.

**Cardiac.** *Per.* heart.

**Cardioid.** Curve traced in space by point in circumference of one circle that is rolling over circumference of another circle. **Cardo.** Hinge of bivalve. Basal joint of insect maxilla.

**Carina.** Any keel-like structure—e.g., that on breast-bone of birds. Median dorsal plate on barnacle. Ridge on glume. Coherent petals. **Carinatæ.** Flying birds with keeled breast-bone. *Cf.* Ratitæ.

**Carnacian.** Late European Neolithic culture c. 3000 B.C. It preceded bronze culture,

**Carnassial.** *Per.* tearing teeth of carnivora, fourth upper pre-molar and first lower molar. **Carnivora.** O. of flesh-eating mammals comprising fissi- and pinni-pedia.

**Carnot's Law.** Second Law of Thermodynamics (*q.v.*).

**Carot-ene, -in.** Yellow pigments of blood, also of chromoplasts; *id.* xanthophyll.  $C_{40}H_{58}$ .

**Carpal.** *Per.* wrist. A wrist-bone.

**Carpel.** One of modified leaves, separate or united, forming a receptacle (ovary) for the ovules of a flower and from which the "fruit" arises. **Carpophyll.** Megasporophyll. **Carpocephalum.** Sporogonial receptacle. **Carpogonium.**

Basal part of *procarp* in red algæ which contains the ovum and which, after fertilization, develops into *sporocarp*. **Carpophagous.** Fruit-eating. **Carpophore.** Part of flower-axis bearing the carpels. Stalk of sporocarp. **Carpophyll.** Carpel. **Carpophyte.** A thallophyte that forms sporocarps. **Carposperm.** Oosphere of algæ after fertilization. **Carposporangia.** Sporangia-forming cystocarp of red algæ. **Carpospore.** Spore of fertilized carpogonium of red algæ.

**Asco-, zygo-spore.** **Carpostome.** Opening in sporocarp for exit of spores. **Carpus.** Wrist. Two rows of bones articulating proximally with radius, distally with metacarpus.

**Cartilage.** Gristle. An elastic tissue composed of a gelatinous matrix in which cells are embedded. C. lines surface of joints and is the forerunner

(foundation) of bone. *See* Collagen.

**Caryopsis.** One-chambered, indehiscent fruit in which a thin pericarp formed from one carpel encloses a single seed.

**Casein.** Phospho-proteid substance in milk, cheese, leguminous seeds, etc. Nucleo-albumen.

**Cassideous.** Helmet-shaped.

**Castration.** Removal of sperm-producing organs (testes) in m. an. or of pollen-producing organs (stamens) in m. (or hermaphrodite) pl. **C., parasitic.** Destruction by parasites of m. gonad-forming tissue with consequent production of a neuter or of a f. from a m. organism. *See* Sacculina.

**Catadioptric.** Having reflecting and refracting power.

**Catadromous.** Migrating down rivers to spawn in sea. *Opp.* anadromous. *Bot.* having lowest inferior div. of a pinna nearer stalk than lowest superior one.

**Catalepsy.** Mental disorder accompanied by blind, unconditioned obedience to stimuli (*e.g.*, suggestions); the limbs often taking up any position in which they are placed. *Cf.* Catatonia.

**Catalysis.** Acceleration or retardation of a chemical reaction due to presence of a substance, the *Catalyst*, which remains without perceptible change. *Ex.* 0.0000014 gramme of mannite decelerates oxidation of sodium sulphite; colloidal platinum, 0.000000002 gramme per gramme will almost immediately change hydrogen peroxide into water and oxygen, a change that would other-

wise take place extremely slowly.

**Catamenia.** Menstruation.

**Cataphoresis.** Migration of suspended particles in a liquid under E.M.F. **Cataphyll.** Rudimentary, scale-like leaf. **Bud.** Corm-scale. **Cataplasia.** Retrogression. **Reversion,** especially when *per.* cell-growth.

**Catarrh.** Infective inflammation of mucous membrane.

**Catarrhines.** Old-World primates with short, or no, tail, with downwardly-directed nostrils separated by narrow septum, Ischial callosities, cheek-pouches, and 32 teeth. More highly-evolved than Platyrrhines (*q.v.*). They include three families: Cercopithec-, Homi-, Simi-idae. **Catatonina.** Blind, unconditioned reaction to stimuli from *within.* *Cf.* Catalepsy.

**Catenoid, -ulate.** Filiform. Chain-like.

**Caterpillar.** Larva of butterflies, moths, etc.

**Catgut.** Tough filament made from intestine of sheep and other an., *excepting* cats.

**Catkin.** Racemose inflorescence bearing many *unisexual*—staminate or pistillate—organs borne laterally on a pendulous rachis or spike. *Syn.* ament. *Ex.* hazel, willow.

**Catoptric.** Having reflecting power. *Cf.* Dioptric.

**Caudal.** Towards posterior region of body. **Caudal vertebræ.** Coccygeal vertebræ. Tail vertebræ. In mammals they vary in no. from 3 (rarely 4 or 5) in man to 50 in ant-eater. In human embryo at end of sixth week the tail is at max. length, being about 1/11

of whole body, then 11 mm. or 2/5 in., and about 10 to 12 vertebræ are represented.

**Caul.** Amniotic membrane enveloping child before birth, especially when membrane is expelled intact. **Caulescent.** Having a stalk. **Cauliculous.** Living on pl. stems.

**Cause.** Anything to which an effect is directly related. Action, or cessation of action, directly connected with sequent change in the thing acted upon.

**Cavicorn.** Hollow-horned.

**Celestial equator.** Great circle formed by a plane including earth's centre and equator extended into celestial sphere. **Equinoctial circle.** **C. latitude.** Angular distance of a heavenly body from the ecliptic measured on arc of great circle passing through body and pole of ecliptic. **C. longitude.** Arc of ecliptic intercepted between vernal equinox and foot of great circle drawn from pole of ecliptic to the ecliptic through the body and reckoning eastwards from equinox. **C. meridian.** Great circle passing through zenith and the poles of C. sphere. Its plane is perpendicular to plane of prime vertical, and its intersections with horizon mark N. and S. points of horizon. **C. poles.** Two points where prolongations of earth's axis cut C. sphere. Sphere of indefinite extent containing the visible heavens.

**Cell.** (1) Small compartment, as that of honeycomb. **Calycle.** (2) Vessel containing electrodes and electrolyte for converting *ch.* into *elec.* energy. **Battery.** (3) A unit living-being living independently (uni-

cell; protozoon; protophyton), or in association with other cells (multicell; metazoon), the former being the state of lower, the latter the state of the higher an. and pl.

A typical c. consists of an aggregate of protoplasm consisting of an external membrane or *c.-wall* surrounding a mass of "body-protoplasm" or *cytoplasm* or cytosome in which is embedded a *nucleus* of karyo- or *nucleo-plasm* which may contain a *nucleolus* or *plasmosome*. The nucleus is often represented by a *macro-* and a *micro-nucleus*. At various stages there may also be represented in a c. *chromatin* (within the nucleus) as granules, threads, or complex reticulate bodies called *chromosomes*; a *contractile-vacuole* and *food-vacuole* may also be present, as well as *attraction sphere*, *centrosome*, *chloroplastids*, *coccoid bodies*, *hyaloplasm*, *metaplasm*, *metaplastids*, pyrenoids, spongioplasm, etc. (*q.v.*). Most lowly organisms probably of a non- or pre-cellular grade, such as ultra-microscopic organisms, filterable viruses, filter-passers which are the probable causes of small-pox, foot-and-mouth disease, distemper, and mosaic-disease of tobacco. Cells vary in size. *Ex.* influenza bacillus, 1/100,000 in.; red blood c., 1/3336 in.; human ovum, 1/125 in.; desmid, 1/20 in.; halicystis, sea alga, 1.2 in. Nitella, a f.w. alga 6.0 in. long.

A c. may be relatively simple, as amoeba, or very complex, as *diplo-dinium ecaudatum* in which are some 43 distinct organs. *See also* Achromatoplasm, Akaryocyte, Antheridium, Bioblast, Brood-, Cap-, Collar-cell, Chroma-fin-, -toplasm, Corpuscle, Cyt-oblast, -ode, -ula, Egg, Embryo, Enchylema, Guard-cell, Hypobasal, Leucocyte, Macro-blast, -mere-, -phage, Neuron, Oocyte, Oogamete, Ovum, Paren-, Prosen-chyma, Pigment-cell, Plastid, Protist, Protoblast, Sertoli-cell, Sperm-cell, -atozoon, Vegetative-cell, Yolk, Zooblast, Zygote, etc.

**C., chloragogen.** One of large cells covering intestines of oligochaets. **C.-colony.** Organized association of cells with div. of labour. **Metazoon.**

**Cenobium.** **Metaphyton.** *Ex.* coral. **C., companion.** Part of phloem. *See* Sieve-tissue. **C.-conjugation.** Union and fusion of two cells. **Cyto-, syn-gamy.** **C.-division.** **C.-fission.** Splitting of one c. into two or more daughter-cells. **Karyokinesis.** **Mitosis.** **Cytodiareresis.** **C., egg-follicle.** **Kalymmocyte.** **C., eosinophile.** **Granulocyte.** **C., excitatory.** **Motor-c.,** especially one of sympathetic nervous system. **C.-fission.** **C.-division.** **C., germ.** A reproductive, as *cf.* c. a somatic cell. **Gamete.** **Spermatozoon.** **Ovum.** **.C., giant.** Any large multinucleated c.—*e.g.*, of spleen and marrow. **Osteoclast.** **Myeloplax.** **C., gland.** **Secreting cell.** **C., glue.** **Colloblast.** **C.-granule.** **Ectosome.** **C., guard.** One of the cells around leaf-stoma. **C., hair.** **C. having a thread-like process.** One of cells of internal ear. **C., head.** One of cells on antheridium. **C., marrow.** **Myelo-cyte, -plast, -plax.** **C., migratory.** **Leuco-, phagocyte.** **C., mother.** Direct ancestor of offspring-cells. **Perispore.** **C., motor.** **Excitatory c.** **Neurone** of motor area of brain. **An effector,** as *cf.* c. a receptor c. **C.-mouth.** **Cytostome.** **C., muscle.** **Myoblast, -cyte.** **C., myo-epithelial.** Very primitive type of c. of simple hydroids, etc.; its outer and superficial part is sensitive, and acts as a *receptor*; its inner and deeper part is contractile, and acts as an *effector*. In higher an. separate cells play part of receptors and effectors. **C., nerve.** **Neuron.** **C., nettle.** **Stinging c.** **Nemato-blast, -cyte, -cyst.** **C.,**

**neutrophile.** C. staining only with neutral stains. Granulocyte. C., pairing. Gamete. Conjugant. C.-plate. Equatorial thickening of spindle fibres from which partition-wall arises during div. of pl. cells. C., pore. Poro-, pylo-cyte. Perforated c. of sponges. C., prickle. C. of deep, stratified epithelium. The "prickles" are marginal connecting fibrils. C., Purkinje. One of the flask-shaped cells between two layers of grey matter of cerebellum. C., reproductive. Gamete. C., ring. Thick-walled c. of annulus of sporangium of fern. C., root. Clear, colourless, base of alga attaching thallus to substratum. C., Rouget. One of the branched cells of capillaries whose contractions and relaxations alter the lumen. C.-sap. Liquid saline material of a vacuole. Fluid part of c.-body or of c.-nucleus. C., sex. Gamete. C., sieve. Thin-walled, elongated c. of sieve-tube. C., somatic. Any c. of the body proper—i.e., exclusive of germ-cells. Histocyte. C., stalk. The barren, as *cf.* c. fertile c., after div. of antheridial c. C., stinging. "Nettle" c. (*q.v.*). C.-substance. Cyto-, karyo-, proto-, spongio-plasm. C., tissue. Histocyte. C.-wall. Boundary, or limiting-membrane investing and protecting pl.-c., which is often common to more than one c.; when young it is composed of cellulose, but later may contain cutin, lignin, mucin, suberin, etc. No cells, not even an. cells, are strictly speaking naked, all have a "wall" of some sort, though it be a mere film or pellicle. C., wandering.

Amœboid c. of mesogloea. Migratory leucocyte of Areolar tissue. Phago-, plano-cyte.

Celli-fugal, -petal. Movement respectively away from and towards a cell. Form of chemotaxis. Cellular. Per. or composed of cells. Locular. Porous. Cellulase. Enzyme that dissolves cellulose. Celluloid. Substance made up of pyroxylin and camphor. Cellulose.  $(C_6H_{10}O_5)_n$ . Carbohydrate forming framework of young pl.-cells. With lignin it forms wood. Present only in few an.—e.g., in test of tunicates. Cotton and unglazed paper are nearly pure c. *Syn.* Lignose; Tunicin.

Cenobium. Cell community. Plasmodium.

Centigrade. C. Thermometer scale *b.p.* 100° and *f.p.* 0° at standard *p.* See Temperature.

Centimetre. Cm. 0.3937 in. 0.01 metre. 10<sup>4</sup> microns. 10<sup>7</sup> millimicrons. C., cubic. c.c. or c.cm. 0.061028 cub. in. Vol. of 1 gramme water at 4° C. 1 millilitre. 10<sup>-6</sup> cub. metres. 1000 cub. mm. C.-gramme. Unit of work; = lifting of 1 gramme against gravity through a height of 1 cm. C., square. 0.155 sq. in. 10<sup>-4</sup> sq. metres. 100 sq. mm.

Central canal. C. enclosed within brain and spinal cord. C. nervous system. Brain and spinal cord of verts. Longitudinal nerve-cord, infra-, and supra-œsophageal, and other ganglia of invertebrates.

Centrifugal. Movement, or force tending to produce movement, away from a centre. Passing from a nerve-centre (brain, cord, ganglion) to an organ—a muscle or gland, etc.

**App.** nerves conveying motor impulses, also to compact, cymose inflorescence having youngest flowers towards periphery. Having radicle turned away from axis of fruit. *Syn.* axifugal; cerebri-fugal; divergent; efferent; ex-centric; tangential. *Opp.* centripetal. **C. force.** Force tending to drive body away from centre; it is  $= \frac{mv^2}{r}$ , where  $m$  = mass

of body,  $v$  = its vel., and  $r$  = radius of curvature of its path.

**Centrifuge.** (1) To subject to centrifugalization. (2) A machine that produces centrifugal force.

**Centriole.** Minute body within attraction-sphere; also particle within centrosome; also centrosome itself. Microcentrosome.

**Centripetal.** Movement, or force tending to produce movement, towards a centre. *App.* racemose inflorescence having youngest flowers at apex. Having radicle turned towards axis of fruit. Passing to a nerve-centre (brain, cord, ganglion) from an organ (eye, skin, etc.). *App.* nerves conveying sensory impulses. *Syn.* afferent. Convergent. Cerebri-petal. *Opp.* centrifugal. **Centrodosome.** Fibrils connecting centrosomes. **Centrolecithal.** *App.* ova with deutoplasm (yolk) concentrated near centre. *Opp.* telolecithal. **Centroplasm.** Protoplasm of centrosphere, also of region in and around aster. Periplasm. **Centriplast.** Extra-nuclear body acting as a kinetic div-centre. **Centrosome.** Body at centre of achromatinic attraction-sphere lying just outside

nucleus and supposed to be the dynamic centre of the cell which influences the orientation of the asters and spindle of mitotic figure. It is sometimes surrounded by centrosphere. *Syn.* astro-centre. Blepharoplast. Centriole. Macro-, micro-centrosome. Periplast. Polar corpuscle. Spermo-centre. *See* Karyokinesis. **Centrosphere.** (1) Zone of differentiated protoplasm (centroplasm) within a cell and surrounding centrosome. Central mass of aster from which rays diverge. Also *app.* mass of aster exclusive of rays and centrosome. It includes (in resting cell) the archoplasm derived from aster and in which the centrosome is embedded. *Syn.* astral sphere. Astro-, micro-sphere. Attraction sphere. *See* Karyokinesis; Perisphere. (2) Central zone of earth. Barysphere. **Centrotrothea.** Idiozome. **Centrum.** Any central body. The "body" of a vertebra from which neural and hæmal arches arise and which, in series, forms the backbone.

**Cephalad.** Towards head or frontpart. **Cephalanthium.** Anthodium. **Capitulum.** **Cephalic.** *Per.* head. **C. index.** A No. obtained by dividing max. head-width by max. head-length and multiplying by 100. *Dolichocephalic* = C.I. up to 75; *sub-dolichocephalic* = 75.1 to 77.6; *mesocephalic* = 77.7 to 80.0; *sub-brachycephalic* = 80.1 to 83.0; *brachycephalic* = 83.1 and above. *See also* under INDEX. **Cephalin.** Lipoid of brain-matter. **Cephalization.** Tendency in ascending ev. to specialization of ant. end of

organisms. **Cephalochordata.** Cl. of *acraniates* represented by amphioxus. Simple *chordates* with persistent notochord and with no well-defined brain. There are 2 species (*q.v.*). **Cephalopods.** Highest cl. of molluscs including cuttlefish, squid, octopus, nautilus. Free-swimming, bilaterally-symmetrical, arm- and sucker-bearing molluscs with cartilaginous brain-case, horny jaws, and often bearing an ink-bag. **Cephalotrocha.** Ciliated larva of turbellarians.

**Cepheid variables.** Stars with light of solar type which, however, regularly fluctuates; a rapid increase being followed by slow decrease.

**Ceratodus.** A dipnoan fish of Queensland with a single swim-bladder that functions as a lung in absence of water. It is a "living-fossil" since Mesozoic times. **Ceratosaurus.** A horned, carnivorous, jurassic dinosaur. It was 6 ft. long, stood 8 ft. high, and hopped like a bird.

**Cercal.** *Per.* tail. **Cercaria.** Tailed larva of trematodes. *See* Alternation. **Cercopithecidae.** Fam. of Old-World monkeys.

**Cere.** Fleishy patch at base of upper part of bird's bill on which nostrils open.

**Cereal.** Any grass producing edible grain.

**Cerebellum.** Ep-, met-, encephalon. Hind-brain. Little brain. The head ganglion of the proprioceptive system.

The hinder and fourth div. of brain that is concerned with the co-ordination of movements that have to be learned, such as walking, piano-playing, etc. It is most highly developed in primates, although fairly well-developed in swimming vertebrates. It is

part of a great sensory mechanism concerned with muscle co-ordination and body orientation and developed in connection with incoming nerve-impulses from joints and muscles.

**Cerebral hemispheres.** Paired lateral zones of the cerebrum occupying dome of skull. **C. vesicle.** Dilated ant. end of tubular central nervous system which is permanent in amphioxus and from which the brain of higher vertebrates has evolved. **Cerebration.** Conscious functioning or thought plus unconscious functioning of brain. **Cerebri-fugal, -petal.** *App.* respectively to nerves transmitting impulses away from (efferent) and to (afferent) brain. *Syn.* centri-fugal and -petal respectively. **Cerebro-ganglion.** Supracesophageal ganglion. **Cerebrospinal.** *Per.* brain and spinal cord. **Cerebrum.** Fore-brain. Encephalon. The organ in man concerned in consciousness, thought, and action.

The great ganglion of *distance-receptors* and evolved primarily by the distance-receptor of smell (olfactory organ). It includes the two cerebral hemispheres or *parencephalon* or right and left *neopallium* which are cross-connected by a band or *commissura* of nerve-fibres (white matter) called the *corpus callosum*. The exterior of the c. is furrowed into *convolutions* for gain of surface area. The outer zone of each convolution is made up of *grey-matter*, a vast collection of *neurons* or nerve-cells in intimate contact-association with one another. It is the neurons that give the grey colour to the grey-matter, *cortex*, or *pallium*. The deeper zone of the convolutions and the subjacent zone are made up of *white matter* composed of *nerve-fibres*, the prolongations of the neurons. As a whole or unit the brain is a *complex of analysers*, the greater part of the cortex being a vast *receptor-apparatus* wherein *nerve-impulses* set going by stimuli from the *outer world* are synthesized and then



analysed and sorted out generally.  
*See* Brain.

**Ceriferous.** Wax-producing.

**Cerium, *ch. el.*** Ce. Metal.  
*At. no.* 58; *at. wt.* 140.13.

**Cerumen.** Yellow wax of Ceruminous glands of ear; also a wax made by stingless bees.

**Cervical.** *Per.* neck, or to neck vertebræ or to "neck" of an organ. **C. sinus.** A discharging duct and aperture in neck due to an unclosed embryonic gill-cavity present in 5th to 6th week of embryonic life. **C. vertebræ.** Vertebræ of neck; 7 in no. in man and most mammals, 6 in manatee, 6 to 10 in sloths.

**Cestodes.** Tape-worms. Platyhelminths.

**Cetaceans.** O. of marine, fish-shaped mammals including whales, dolphins, and porpoises.

**C.G.S.** Centimetre-gramme-second system of units.

**Chæta.** Spine or bristle of worms. Cilium of protozoa. **Chæt-iferous, -igerous, -ophorous.** Bearing or producing bristles. *Cf.* Eremochætous. **Chætopods.** Bristle-worms. *Ch.* of annelids.

**Chain-reaction.** (1) Sequence of reflexes each of which, except the first, is set going by the preceding. *Ex.* frog sees fly—frog's mouth opens—tongue protruded—tongue curls round fly—tongue withdrawn—mouth closed—tongue unrolled—fly swallowed. (2) A sequence of ch. reactions in which energy of reaction is transferred to the mols. of the reactant, activating them. *Ex.* one light-quantum acting on any no. of mixed H and Cl mols. explodes the mixture and

unites the H and Cl to form hydrochloric acid, HCl.

**Chalaza.** One of two spiral bands attaching yolk to egg-membrane. Stalk by ovule. **Micella**—attachment to ovule-integuments. **Chalazogamy.** Type of fertilization in which pollen-tube enters ovule at opp. pole to micropyle and pierces chalaza to reach ovum. **Basigamy.** *Cf.* Porogamy.

**Chalk.** Limestone. Calcium carbonate.  $\text{CaCO}_3$ , composed of foraminifera shells.

**Chalone.** Inhibitory autacoid (*q.v.*) or endocrine. *Cf.* Hormone.

**Chalybeate.** Impregnated with iron salts.

**Chance.** A happening resulting from incalculable, untraced, or unknown forces. Absence of assignable intention in a phenomenon. Probability.

**Chaos.** Confused, disordered state, especially as a stage in cosmic evolution. *Cf.* Cosmos.

**Character.** Most elastic term in biology. Any part or function of an organism. A "body-c." is a complex of many germ-characters called *determiners* or *factors*. A sum of traits conferring distinctiveness. A feature—*e.g.*, "colour," "form," "size." **C., acquired.** A somatic modification of a multicellular organism acquired during, and persisting throughout, its lifetime, and directly induced by some change in its environment, or in its own functioning, and such that the modification so produced persists *after* the inducing agent ceases to act. **Characteristic.** A distinguishing trait or quality in an individual.

**Charge.** The excess (negative c.) or deficit (positive e.) of *electrons* in a conductor. The excess (positive c.) or deficit (negative c.) of *protons* in a conductor. **C.,** unit of. Electro-magnetic unit (E.M.U.) is the quantity of elec. delivered by unit current in 1 sec.; it is = 10 coulombs.

The electro-static unit (E.S.U.) of c. is the quantity of elec. that repels an = quantity 1 cm. distant *in vacuo* with a force of 1 dyne; it =  $\frac{1}{9} \times 10^{-9}$  coulomb. C. of electron =  $1.5900 \pm 0.0013 \times 10^{-29}$  E.M.U. or  $4.7668 \pm 0.0038 \times 10^{-10}$  E.S.U. or  $1.5921 \times 10^{-19}$  abs. coulomb. 1 E.M.U. = 10 coulombs or is =  $2.99796 \times 10^{10}$  E.S.U.; and one E.S.U. =  $3.33560 \times 10^{-10}$  abs. coulomb, or is =  $2.0947 \times 10^9$  electronic charges, or is =  $3.33560 \times 10^{-11}$  E.M.U.

**Charles's law.** See Dalton.

**Chasmogamy.** Opening of flowers for cross-fertilization. *Opp.* cleistogamy.

**Chasmophily.** Inhabiting cracks, nooks, crevices, etc.

**Chela.** Finger-like claw.

**Chelicera.** Fore chelate, mouth appendages of arachnids.

**Chelonia.** O. of reptiles. Tortoises, terrapins, turtles.

**Chemical affinity.** Force (elec.) holding atoms together in a mol. *Cf.* Cohesion.

**Chemistry.** Science of the composition and transformations of matter. **Chemonasty.**

Response to diffuse ch. stimuli.

**Chemoreceptor.** End-organ for reception of ch. stimuli. *Ex.* taste and smell organs. **Chemotaxis.**

Reaction to ch. solutions. Movement of organisms, or of their parts, towards

or away from greater concentration of a ch. solution. **Chemotropism.**

Aero-, Tonotaxy. *Ex.* malic acid diffusing from archegonium of fern at-

tracts m. to f. gamete; moss m. gamete moves towards sugar solution, cholera bacillus towards potato-sap. **Chemotropism.** Orientation of organism, more especially of its parts, in relation to ch. solutions. **Chemotaxis.** *Ex.* movement of pl. rootlets towards dilute saline solutions.

**Chiasma.** Decussation. Intersection. Crosswise mating of chromosomes. **Chiasmotypy.** Recombination of chromosome substance in syndesis.

**Chimpanzee.** Catarrhine primate of equatorial Africa. *Anthropopithecus.*

*Cfd.* c. gorilla it approximates to man in dentition, eyelashes, eyebrows, whiskers, length of arms, structure of liver, and in being lively and teachable; it is less human-like than gorilla in its ears and ear-muscles, smaller brain, smaller buttocks, shorter nasal bones and less erect gait.

**Chiroptera.** O. of placental, flying mammals—the bats. **Chiropterophilous.** Pollinated by bats. **Chiropterygium.** Five-fingered limb of higher verts.

**Chitin.** Horny substance of skin, especially that of arthropods, and also of skeleton of sponges.  $C_{15}H_{20}N_2O_{14}$ .

**Chlamydate, -deous.** Furnished with a mantle (*e.g.*, molluscs) or with a perianth (pl.). **Chlamydospore.** Thick-walled resting-spore.

**Chloragen.** Yellow cells surrounding annelid intestine.

**Chloranth.** Reversion of floral to ordinary green leaves.

**Chlorenchyma.** Chlorophyll-containing tissue.

**Chloride.** Compound of chlorine with another el. or radicle. **Chlorine, ch. el.** Cl. Gas. *At. no.* 17; *at. wt.* 35.457.

**Chlorocruorin.** Green iron-containing respiratory pigment in worms. Chloroform. Anæsthetic.  $\text{CHCl}_3$ . **Chlorophyceæ.** Bluish-green algæ. **Chlorophyll.** Green colouring-matter of pl. Leaf-green. A green colloidal substance associated with *chloroplasts* of pl. protoplasm.

In solution c. is green by transmitted, but red by reflected light. C. fluoresces, modifies light-rays, and absorbs especially the rays towards red end of spectrum. Potassium is essential to its assimilating activity; iron, and sometimes manganese, to its formation. With sunlight c. separates oxygen atoms from carbon dioxide and water and stores up energy of hydrogen and carbon products in carbohydrates. This energy, obtained by *deoxidation*—i.e., separation of oxygen—is released through *oxidation*—i.e., by addition of oxygen. In development the first form of c. is a mixture of carotinoids called *etioline*. Pl. grown in deficient light are *etiolated*—i.e., etioline has not evolved to chlorophyll. Pl. grown in absence of iron have colourless *chloroplasts* and are said to be *chlorotic*. Chlorosis thus differs from etiolation in that in the former the paleness is due to failure of *leucoplasts* to develop into chloroplasts in absence of iron, and in the latter it is due to failure of etioline to develop into c. in absence of light. c. really consists of 4 pigments, 2 green, 1 orange, and 1 yellow, and there are two varieties of it, an A- and a B-c. The mol. of c. is large—e.g., c.-A contains as many as 136 atoms,  $\text{C}_{51}\text{H}_{77}\text{O}_6\text{N}_2\text{Mg}$ . An average percentage composition is: C, 73.34; H, 9.72; O, 9.54; N, 5.68; P, 1.38; Mg, 0.34. Cf. Hæmoglobin. See Chlorosis.

**Chloroplast, -id.** Green, chlorophyll-carrying proteid in pl.-cells which originates from a leucoplast. An average leaf contains 320,000,000 chloroplasts to the sq. in. *Syn.* auto-, tropho-plast. See Chlorophyll. Chromoplast. **Chlorosis.** (1) Form of anæmia in man due to deficiency of

iron in the blood, this el. being necessary to formation of hæmoglobin. (2) Form of anæmia in pl. due to deficiency of iron in soil, this el., though not a constituent, being necessary to formation of chlorophyll (*q.v.*).

**Choana.** Any funnel-shaped opening. **Choanocyte.** Collar-cell; the flagellated cell of sponge.

**Cholesterin.** A white, solid monatomic alcohol (lipoid) present in bile, brain, yolk.  $\text{C}_{27}\text{H}_{45}\text{OH}$ . See Ambergis.

**Chondrification.** Formation of cartilage. **Chondriocent.** Chondriosome. **Chondriomere, -ite.** Chondrioplast. A chain of chondriosomes. **Chondriosomes.** Small, refractive bodies in cell-protoplasm including bioblasts, chondriocents, -meres, -mites, -plasts, -spheres, mitochondria, plastomeres, sphæroplasts, etc. **Chondriosphere.** Aggregated or spherical chondriosomes. **Chondroblast.** Cartilage-forming cell. **Chondroclast.** Large, many-nucleated cartilage-absorbing cell. **Osteoclast.** **Chondrocranium.** Cartilaginous cranium. Primitive or embryonic skull.

**Chord.** Right line joining extremities of an arc. **Chorda dorsalis.** Notochord. **Chordacentrous.** *App.* vertebræ formed from notochord sheath. Cf. Arcicentrous. **Chordates.** Group of multicellular an. possessing notochord, comprising the *cephalo-*, *hemi-*, and *urochordata* and the *craniata* or *verts.* proper. **Chordotonal organ.** Grouped, bristle-like sensillæ in insects. It has probably a tactile, vibration-perception, and auditory func-

tion. See Scolophore. *Syn.* rhythmometer.

**Chorion.** Membrane in f. pregnant mammals; it encloses amnion and embryo. Egg-membrane of insects. See Allantois, Placenta, Trophoblast.

**Choripetalous.** Having separate petals. **Choriphyllous.**

Having perianth divs. distinct. **Chorisepalous.** Having separate sepals. **Choroid.** Layer of eye between retina and sclerotic. Vascular membrane of brain-ventricles. **Chorology.** Geographical distribution of organisms.

**Chromaffin.** Chromophil. Pigmented cells derived (in fishes) from sympathetic ganglia, and (in human embryo) from corresponding vertebral ganglia. They stain readily with chromium salts. In higher verts. they form the medulla of suprarenal bodies and (in adults) secrete adrenalin. **Chromatic.** *Per.* colour or to tones that serially vary in pitch. Stainable. **C. aberration.** Formation of coloured fringe at edge of image formed by a simple lens in consequence of differences in wave-lengths of various light-waves. **Chromatid.** A univalent chromosome. Half chromosome between pro- and meta-phase. One component of tetrad in meiosis. **Chromatin.** Deeply-staining els. forming part of chromosomes and nuclear network.

In its simplest and most primitive form c. exists as *granules*, later as *threads*. c. is the physical basis of heredity; it is the substance which, by its inherent organization, involves the characteristics of the species. There are two kinds: *somatic c.* in the body-cells and *germinal or heredity c.* in the germ-cells. *Syn.* idioplasm, germ-plasm; chromidia; karyotin.

**Chromatocyte.** Pigment-cell.

**Chromatolysis.** Chromatin dissolution.

**Chromatophore.** Pigment—holding part of cytoplasm. Plastid. Chloro-, chromo-plast. Chromoblast. Chloroplastid. See Pyrenoid.

**Chromatophyll.** Chromophyll. Colouring-matter of flagellates.

**Chromatoplasm.** Vegetative part of cell as *cf.* c. active idioplasm. Substance of pigment-bearing protoplasm. Granular part of protoplasm as *cf.* c. colourless achromatoplasm, chromoplasm. Tigroid body. Nissl body. **Chromatoplast, -id.** Chromoplast.

**Chromatospherite.** Nucleolus.

**Chromidia.** Extra-nuclear particles of chromatin. Intracellular particles of chromatin in unnucleated cells. Precursors of nucleus in nuclear ev.

**Chromidiosome.** Chromatin particle. Unit granule in the aggregation which forms a chromomere. *Syn.* chromiole.

**Chromiole.** A chromidiosome (*q.v.*).

**Chromium, ch. el.** Cr. Metal. *At. no.* 24; *at. wt.*

52.01. **Chromoblast.** Embryonic pigment-cell. Chromatophore. **Chromocyte.** Pigment-cell.

**Chromogen.** Material in a cell which, by oxidation, becomes pigment. **Chromomere.** Smallest identifiable particle in a chromosome between leptotene and pachytene stage. A gene or collection of genes. Aggregate of chromatin granules that make up chromosome.

Grouped chromidiosomes. **Chromonema.** Convoluted thread of chromosome during mitosis.

**Chromophane.** Red, yellow, and green oil-globules in retinal cones. Xanthophane.

**Chromophil.** Chromaffin. Phæochrome. **Chromophilic cell.** Readily-staining cell. **Chromophobe.** Pituitary cell. Cell not staining readily. **Chromophore.** Pigment-containing cell or body. An atomic aggregate causing absorption band in spectrum. *Ex.* carbon monoxide. CO. **Chromophyll.** Chromatophyll. **Chromoplasm.** Chromatoplasm. **Chromoplast.** Pigment-bearing cell. Pigment-plastid producing colours of flowers and fruits; they arise from leucoplasts. *Syn.* chromatoplast.

**Chromosome.** One of paired structures carrying the genes present in nucleus that is about to divide. A thread of linin along which chromatin granules are arranged like a string of beads.

A c. is one of many deeply-staining bodies (the no. of which is constant for the cells of a species) into which chromatin granules resolve themselves during karyokinesis and meiosis; the chromatin granules arrange themselves into filaments and these break up into rods, each rod representing a c. There are two kinds of c.—*autosomes*, responsible for general bodily characters, and *sex-c.*, or *x* and *y c.*, usually two in no., carrying sex-linked genes and having sex-directing influence in the zygote.

In the conjugating m. and f. germ-cells the no. of c. is halved in each cell just before conjugation, so that the specific no. characteristic of the species is not doubled but kept constant. Thus in man there are 48, in pea 14, in crayfish 200 c. *Syn.* idant; karyo-mite, -some. *See* Chromioid; Cytosome; Karyomite; Karyosome; Sex.

**Chromosphere.** Gaseous sphere around sun above photosphere and reversing layers. From it the *prominences* are hurled up. Stratosphere photographs taken June 8, 1937, show sun's atmosphere to be a million

miles deep and corona (outside chromosphere) to be 100 times vol. of sun.

**Chronoscope.** Instrument for measuring minute time-intervals.

**Chrysalis.** Pupa of insects.

**Chrysocarpous.** Yellow-fruited. **Chrysophyll.** Yellow decomposition product of chlorophyll.

**Chyle.** Lymph containing emulsified fat droplets present in thoracic duct, lymphatics, and lacteals. It is the medium of transfer of fats to blood. **Chylo-caulous, -phyllous.** Having a fleshy stem or fleshy leaves.

**Chyme.** Partly-digested food—*i.e.*, as it leaves the stomach.

**Cicatrix.** Fibrous tissue of a scar.

**Cilia.** Hairs. Eyelashes. Hair-like cell-processes. Feelers. Barbicels.

As minute protoplasmic extensions of cells c. are organs for locomotion or for making currents of water which carry mucus and foreign bodies out of air-passages, waste products out of an organism, ova along a tube, or which carry food-particles into an organism's digestive cavities, etc. Each cilium is a long, thin protoplasmic projection from a cell which by its to-and-fro lashings *propels* or *drags* the cell as a whole through the water, or *propels* the water past a fixed cell. *See* Cirri; Flag-, Puls-, Tract-ellum.

**Ciliata.** *Sub-cl.* of protozoa.

**Cimex.** Bed-bug.

**Cingulum.** Any band- or girdle-like structure—*e.g.*, that of rotifers and diatoms. Clitellum.

**Circinate.** Rolled about an axis like a coil of rope. **Circle.** Closed plane curve with every point equidistant from centre. **C., area.**  $0.7854 \times \text{diameter squared}$ . **C., circumference.**

3-14159  $\times$  diameter. C., diameter. Circumference div. by 3-14159. Circulation. Movement [due to differences of pressure (Man: max. + 5-46; min. - 1-56 ins. of mercury)] of blood through heart, arteries, capillaries, and veins. Flow of sap. Intracellular protoplasmic streaming.

Circumduction. Motion of a limb such that its long axis describes a cone with the joint at the apex. Circumnutation. Spiral motion of tip of growing pl.-stem.

Cirri. Sing. cirrus (q.v.). Hair-like appendages. Tendrils. Cilia specialized as "oars." Barbels. Respiratory and tactile appendages. Cirripedia. Degraded marine crustaceans. Barnacles. Cirrus. Plural cirri (q.v.). High altitude, streaky clouds consisting usually of minute ice-crystals. Mares'-tails.

Cisoid. Curve by continuous motion discovered by Diocles.

Citric acid. Acid of lemon and other fruit juices.  $C_6H_8O_7$ .

Cladanthous. Having terminal archegonia on short side-branches. Clado-, pleurocarpous. Cladogenous. Cladautoicous. Having antheridia on a special stalk. Cladocarpous. Cladanthous. Cladode. Branch arising from leaf-axil which closely resembles a foliage leaf. Cladophyll. Phylloclade. Cladogenous. Cladanthous. Cladophyll. Cladode. Cladoptosis. Annual shedding of twigs. Cladose. Branched. Clasmatocyte. Vacuolated cell. Macrophage.

Claspers. (1) Fins and other organs, modified to enable m.

to hold f. during sexual congress. Hypopyge. Myxopterygia. Rhabdopod. See Bursa copulatrix; Spermatheca. (2) Climbing shoots and tendrils.

Classification. Systematic arrangement of organisms wherein individuals are grouped as a variety (Ex. Burnet rose, Chinese tiger); varieties as a species (Ex. *Felis tigris*, *Rosa spinosissima*); species as a genus (Ex. *Felis*, *rosa*); genera as a family (Ex. *Felidae*, *Rosaceae*); families as an order (Ex. *carnivora*, *archichlamydeae*); orders as a class (Ex. mammals, dicotyledons); classes as a series (Ex. vertebrates, angiosperms); series as a kingdom (Ex. animals, plants).

Each of such divs. may be further split up or extended as—e.g., sub-c., cohort, phylum, grade, etc. Take, as an ex. the following c. of a modern Englishman: *Sub-race*: Mediterranean. *Race*: e.g. Nordic. *Species*: *Homo sapiens*. *Genus*: *homo*; *hominidae*. *Sub-order*: *anthropoidea*. *Order*: *primates*. *Class*: *mammalia*. *Sub-cl.*: *eutheria*. *Phylum*: *chordata*. *Sub-phylum*: *vertebrata*. *Section*: *craniata*. *Sub-kingdom*: *metazoa*. *Kingdom*: *animalia*. *World*: *organic*.

C., an.

*Sub-kingdom* 1. Unicellular animals. PHYLUM 1. Protozoa. Cl. 1. Sarcodina. Cl. 2. Mastigophora. Cl. 3. Infusoria. Cl. 4. Sporozoa. *Sub-kingdom* 2. Many-celled animals. Metazoa. PHYLUM (= P.) 1. Porifera. P. 2. Coelenterata. Cl. 1. Hydrozoa. Cl. 2. Scyphozoa. Cl. 3. Actinozoa. Cl. 4. Ctenophora. P. 3. Platyhelminthes. P. 4. Nemathelminthes. P. 5. Trochelminthes. P. 6. Molluscoidea. Cl. 1. Bryozoa. Cl. 2. Brachiopoda. P. 7. Echinodermata. Cl. 1. Asteroidea. Cl. 2. Echinoidea. Cl. 3. Holothuroidea. Cl. 4. Crinoidea. (Cystoidea. Blastoida. Extinct.) P. 8. Annulata. P. 9. Arthropoda. Cl. 1. Crustacea. Cl. 2. Arachnida. Cl. 3. Myriapoda. Cl. 4. Hexapoda (Insecta). P. 10.

**Mollusca.** *Cl.* 1. Pelecypoda. *Cl.* 2. Gastropoda. *Cl.* 3. Cephalopoda. *P.* 11. Chordata. *Cl.* 1. Hemichordata. *Cl.* 2. Urochordata. *Sub-P.* 1. Vertebrata. *Section* 1. Cephalochordata or acraniata. *Sec.* 2. Craniata. *Cl.* 1. Cyclostomata. *Cl.* 2. Pisces. *Cl.* 3. Amphibia. *Cl.* 4. Reptilia. *Cl.* 5. Aves. *Cl.* 6. Mammalia. *Sub-cl.* 1. Prototheria. 2. Metatheria. 3. Eutheria. *Order* 1. Edentata. *O.* 2. Marsupialia. *O.* 3. Ganodonta. *O.* 4. Ungulata. *O.* 5. Sirenia. *O.* 6. Cetacea. *O.* 7. Creodontia. *O.* 8. Carnivora. *O.* 9. Tillodontia. *O.* 10. Rodentia. *O.* 11. Insectivora. *O.* 12. Chiroptera. *O.* 13. Primates.

**C., pl.**

**GROUP 1. Thallophyta.** *Cl.* 1. Algae. *Sub-cl.* 1. Chlorophyceae. *Sub-cl.* 2. Phaeophyceae. *Sub-cl.* 3. Rhodophyceae. *Sub-cl.* 4. Cyanophyceae. *Cl.* 2. Fungi. *Sub-cl.* 1. Bacteria. *Sub-cl.* 2. Phycomycetes. *Sub-cl.* 3. Ascomycetes. *Sub-cl.* 4. Basidiomycetes. *Sub-cl.* 5. Lichens. (Fungusymbiotic with alga.) **GROUP 2. Bryophyta.** *Cl.* 1. Hepaticae. *Cl.* 2. Musci. **GROUP 3. Vascular plants.** **SUB-GROUP 1. Vascular cryptogams or pteridophytes.** *Cl.* 1. Filicales. *Cl.* 2. Lycopodiales. *Cl.* 3. Sphenophyllales. *Cl.* 4. Equisetales. **SUB-GROUP 2. Vascular flowering plants or phanerogams.** *Cl.* 1. Gymnosperms. *Order* 1. Gnetaeae. *O.* 2. Coniferae. *O.* 3. Ginkgoeae. *O.* 4. Bennettiteae. *O.* 5. Cycadeae. *O.* 6. Cordaiteae. *Cl.* 2. Angiosperms. *Sub-cl.* 1. Monocotyledonae. *Div.* 1. Glumiflorae. *Div.* 2. Liliflorae. *Div.* 3. Microspermæ. (3 divs., sub-div. into 48 Orders.) *Sub-cl.* 2. Dicotyledonae. *Div.* 1. Achlamydeae (sub-div. into 177 Orders). *Div.* 2. Sympetaleae (sub-div. into 51 Orders)

**Clathrate, -ose.** Lattice-like.

**Claustrophobia.** Fear of confined spaces.

**Clavate.** Club-shaped.

**Clavicle.** Collar-bone. Bone forming *ant.* part of shoulder-girdle and connecting arm to trunk; absent, or rudimentary, in carnivora and ungulates. **Clavus.** Ovipositor shaped like elephant's trunk.

**Clay.** A sedimentary de-

posit; hydrous silicate of alumina.

**Cleavage.** Splitting of rocks into thin sheets. *Ex.* slate. *Cf.* Lamination. Splitting of crystal par. to a face. **Cell-div.** Series of divs. of egg-cell following maturation and fertilization. **C. nucleus.** Nucleus resulting from fusion of m. and f. pro-nuclei.

**Cleistocarp.** Closed ascocarp with internally-produced spores. **Cleistothecium.** **Cleistogamy.** Autogamy. Condition in which cert. inconspicuous flowers do not open and self-fertilization takes place within the closed flower. *Ex.* violet. *Cf.* Chasmogamy. *See* Self-fertilization. **Cleistogene.** **Cleistogamous flower.** **Cleistothecium.** **Cleistocarp.**

**Climacteric.** Time of life when menstruation ceases.

**Clinic, -al.** *Per.* bedside or to patients.

**Clitellum.** Accessory sex-gland organ that secretes egg-or sperm-cocoon in worms.

**Clitoris.** Representative of phallus in f.

**Cloaca.** Dilatation of hind-gut forming common outlet for urine, fæces, and sexual products in most verts., higher mammals excepted. It is well marked in human embryo in 4th week, at which time condition resembles persistent condition in frog, but by end of second month the cloacal membrane is absorbed.

**Clone.** An asexually-produced individual or a parthenogenetically-produced chain of individuals (*ex.* aphides) or of budded-off individuals (*ex.* hydras). **Plant-sucker.** *Desma.*

**Clonic.** Irregular. Convul-

sive. *Cf.* Tonic. **Clonus.** Series of muscle contractions and relaxations in which each separate contraction is observable. Incomplete tetanus.

**Cloud.** *See* Fog.

**Clutch.** Coupling by which two working parts can be connected or disconnected.

**Clype-ole, -us.** Any shield-shaped structure—*e.g.*, that in front of insect's head. A type of sporophyll.

**Cnid-a, -oblast.** Stinging-cell with its nematocyst and cnidocil. **Cnidocil.** Sensitive receptor in cnidoblast. **Cnidophore.** A nematocyst-bearing zooid. **Cnidopod.** Stalk or support of cnidoblast. **Cnidosome.** An assemblage ("battery") of cnidoblasts.

**Coagulation.** Chemical changes initiating and going on during passage from a liquid to a semi-solid or jelly-like state. **Curdling.** Clotting. **Coagulum.** A coagulated mass. **Clot.** **Gel.**

**Coal.** Organic rock, up to 3000 ft. depth, mostly of pl. (slightly of an.) origin, and composed of C, H, O, N, and S. c. contains more C but less O than peat, but a complete series can be traced from wood to peat, to lignite (brown c.), to bituminous or soft c., to anthracite or hard c. and ending in graphite.

**Coarctate.** Closely connected. Pressed together. Joined by a constriction, as thorax and abdomen of wasp.

**Cobalt, ch. el.** Co. Metal. *At. no.* 27; *at. wt.* 58.94.

**Cocaine.** Crystalline alkaloid of coca.  $C_{17}H_{21}NO_4$ . It anesthetizes and then paralyzes nerve-cells.

**Cocci.** Minute spherical bac-

teria. **Coccidia.** Parasitic protozoa. **Coccogone.** Alga gamete.

**Coccygeal.** *Per.* coccyx. **Coccyx.** In man the c. consists of 3 to 5 vestigial caudal vertebrae.

In anthropoid apes these vertebrae are even more vestigial than they are in man. In a fifth- to eighth-week human embryo the c. protrudes from the body as a *true tail* and contains representatives of 8 to 11 vertebrae. In 10 p.c. of humans there are vestiges of muscles (extensors, flexors, agitators) that moved the tail. Sometimes small bones lie in front of coccyx—remains of chevron bones to which tail-depressors are attached in other mammals. *See* Tail.

**Cochlea.** The spirally-coiled (like a snail-shell) organ of hearing in labyrinth of internal ear. *See* Lagena.

**Cockroach.** Popularly called "black-beetle," though it is *not* a beetle, but belongs to family *Blattidae* of the O. *Orthoptera*.

**Cocoon.** Envelope of silk-like material within which insect passes pupa stage. Coating of hardened mucus in which lung-fish *Protopterus* encapsulates itself in absence of water. Protective covering to eggs of insects, worms, arachnids, etc.

**Coefficient.** Measure of capacity of a substance to act in some specific way. A symbol indicating a multiplier. *See, e.g.,* Concentration.

**Coelenterates.** Radially-symmetrical invertebrates, with single body-cavity and armed, as a rule, with stinging-cells. *Ex.* jelly-fish. There are 7,000 species (*q.v.*). **Coelenteron.** Archenteron. Body-cavity.

**Coeloblast.** Plurinuclate



cell. **Coenocyte**. Embryonic layer derived from endoblast. A div. of embryonic hypoblast. **Coeloblastula**. Blastula with a blastocoel. **Coelogastrula**. Typical gastrula with segmentation-cavity. **Coelom**. Body-cavity. Space between outer tube or body-wall and inner tube or gut. *Cf.* **Hæmocoel**. **Coelomata**. An. possessing coelom. *Ex.* all metazoa exclusive of sponges and coelenterates.

**Coenenchyma**. Common tissue connecting together all polyps or zooids of a compound coral. **Coenobium**. A loose, primitive, "colony" or collection of unicells. Collection of unicellular organisms surrounded by a common membrane, possessing no marked differentiation of reproductive and vegetative units. *Cf.* **Plasmodium**. **Coenoblast**. Germ-layer preceding and originating endo- and mesoderm. **Coenocyte**. Plurinu- cleate mass of protoplasm, sometimes filamentous throughout. Multicellular pl. *without* cell-walls. Uni-cell *with* cell-wall and numerous nuclei. **Syncytium**. **Plasmodium**. **Coenocium**. Common investing and supporting (basal) substance uniting individual polyps of a polyzoan colony. **Coenosarc**. **Coenogamete**. Plurinu- cleate gamete. **Coeno- sarc**. **Coenocium**. **Coenosteum**. Common calcareous skeleton of compound coral. **Coenothecaly**. Condition in which body-walls of zooids are all fused together into a common mass. **Coenozygote**. Zygote formed by conjugated coenogametes.

**Coercive force**. Demagnetizing force.

**Cognition**. *Direct* apprehension as *cf.* c. re-cognition.

**Cohesion**. Union of like parts. Force which holds together mols. which are chemically similar and at insensible distances apart. By c. solids keep their shape and resist rupture. *Cf.* **Adhesion**, **Chemical affinity**.

**Coition**. **Copulation**. Sexual congress.

**Coleoptera**. Beetles. An enormous group (about 250,000 species) of insects with hard, horny pair of front-wings covering a membranous pair of hind-wings. **Coleoptile**. First, protective leaf of monocotyledon seedling. **Coleorhiza**. Cell-layer around radicle.

**Collagen**. Ground-substance of cartilage (*q.v.*); a gelatinous protein which, boiled, yields gelatin.

**Collar-bone**. **Clavicle** (*q.v.*). **C.-cell**. **Funnel-cell**. **Choanocyte**.

**Collembola**. Primitive, wingless insect. **Springtail**.

**Collenchyma**. Thickened, supporting, but still living cells of pl.-stem. Mesodermal tissue of sponge. **Collencyte**. Pseudopodial cell of sponge collenchyma. **Colloblast**. Glue-cell on surface of ctenophore tentacle.

**Colloid**. Gel. Jelly. A gummy, gelatinous, non-crystalline, labile substance composed of relatively very large mols. which does not form a true solution, exercises but little osmotic pressure, and therefore only diffuses slightly through membranes. *Ex.* gum; white-of-egg; proto-

plasm. *Cf.* Crystalloid. Also *app.* very finely-subdivided particles varying from 1/250,000 to 1/25,000,000 in. d. suspended in a liquid. *Ex.* colloidal gold.

**Colon.** Large bowel of verts. between ileum proximally and rectum distally. Second part of insect intestine.

**Colony.** A mass of brood-cells, cells, bacteria, etc., that remain temporarily or permanently in contact. A metazoon. A collection of isolated organisms (ants, bees), of partly united organisms (zoogloea, ctenobium), or of permanently and completely united organisms (coral).

**Coloration.** *Zoo.* Types: aggressive, alluring, confusing, cryptic, mimetic, protective, recognition, seasonal, sexual, signal, sympathetic, warning, etc. **Colour.** Sensation aroused in brain after impact on cones of retina of radiant energy of sp. w.-l. and intensity.

The following shows the *wavelengths* (w.-l.) in millionths of an inch, also the *frequencies* (fr.)—i.e., no. of waves entering eye per sec. in English billions (million-millions) for each colour: Less than 14 w.-l. and more than 833 fr. are *invisible* ultra-violet, X-ray, gamma, and cosmic waves). *Violet*, 14 to 16 w.-l.; 833 to 697 fr. *Indigo*, 16 to 17 w.-l.; 697 to 653 fr. *Blue*, 17 to 19 w.-l.; 653 to 609 fr. *Green*, 19 to 21 w.-l.; 609 to 545 fr. *Yellow*, 21 to 23 w.-l.; 545 to 509 fr. *Orange*, 23 to 25 w.-l.; 509 to 463 fr. *Red*, 25 to 30 w.-l.; 463 to 394 fr. More than 30 w.-l. and less than 394 fr. are *invisible* infra-red, hertzian, and wireless waves. Each of these 7 *chromatic* colours (some reduce them to 4 primary colours—blue, green, yellow, red) is sub-divided into many sub-hues; violet, e.g., proceeding from shorter to longer w.-l., is div. into heliotrope, amethyst, orchid, royal purple, wisteria, and lavender,

and so on. The *achromatic* colours are black, white, and intermediate greys.

**Colostrum.** First three days' milk after child-birth.

**Columbium**, *ch. el.* Cb. Metal. *At. no.*, 41; *at. wt.* 92.91. *Syn.* Niobium, Nb.

**Columella.** (1) A column- or club-shaped thickening or projection—e.g., of hypha into sporangium. (2) Axis of cochlea. (3) Ear-bone of amphibia, reptiles, and birds. Epipterygoid. Carpophore. (4) Pillar about which whorls of a shell are coiled.

**Coma.** Deep insensibility. Seed-hairs. Terminal bracts. Berenice's constellation.

**Comanchean.** Part of Mesozoic period; it follows Jurassic and precedes upper Cretaceous. *Syn.* Lower Cretaceous.

**Comatula.** Free-swimming crinoid.

**Combustion.** Oxidation of sufficient rapidity and heat-production to cause flame. *Cf.* Detonation.

**Comets.** Irregular-shaped heavenly bodies moving in curves about the sun. Some, belonging to our solar system, move in an ellipse with consequently a periodic return; others, possibly wanderers from outer space into our system, move in parabolic or hyperbolic orbits and do not return. Many c. possess a "tail," consisting of a luminous fog, which points away from the sun.

**Commensal, -ism.** An organism that lives in association with, but not necessarily parasitically on, another organism of a different species, and partakes of the same food, both

species benefiting by the association. *Ex.* crab and sea-anemone, shark and pilot-fish. *Syn.* inquiline; communism. *Cf.* Parasitism; Symbiosis.

**Commissure.** Line or band of union between two parts. Carpellary cohesion. Nerve strands connecting paired parts of brain.

**Communalism.** An an. association involving extreme *div. of labour* and often extreme *physical differentiation*; present in only two groups, insects (bees, ants, termites) and man. **Communism, bio.** Commensalism.

**Commutator.** An arrangement of mutually-insulated copper segments mounted on shaft of dynamo or of a direct-current motor for rectifying (commutating) induced currents or collecting and conveying direct currents to conductor. A switch for reversing direction of electric current.

**Compass Plant.** A pl. the leaves of which are permanently orientated so as to indicate a N. and S. direction. *Ex.* prairie lotus.

**Complement.** A thermo-labile substance present in fluids of all living matter which assists in destruction of foreign bodies, bacteria, etc. *Syn.* alexin.

**Complex.** *Opp.* of simple. (1) *App.* intricately-involved archaic rocks. (2) Any one of a system or "constellation" of ideas, memories, images, and desires, especially such as normally lie quiescent in the background of consciousness. *Ex.* inferiority complex.

**Component.** A constituent of a system. An ingredient of

a mixture. A part of a compound. The *effective* value of forces acting on a body. One of a no. of forces the combined effect of which is a *resultant*. One of the parts into which a force, momentum, or velocity can be resolved. One of the colours into which mixed light can be resolved, or one of the notes into which a complex sound can be resolved.

**Compositæ.** Large group of pl. in which inflorescence consists of many small flowers collected in a dense "head" the base of which is enclosed in a common envelope. *Ex.* daisy. *Syn.* Asteraceæ.

**Compound.** A substance in which there is more than one mol., and all the mols. are alike. A substance consisting of atoms having different *at. nos.* (nuclear charges) in definite and simple numerical ratios. A substance formed of 2 or more *elements (q.v.)* united by *ch. affinity*. *Ex.* water,  $H_2O$ , is a compound of the 2 *els.* H and O.

**Compsognathus.** Smallest recorded dinosaur. A fierce, active, toothed, carnivorous bird-like reptile of upper Jurassic.

**Compton shift.** Lengthening of short ("hard") X-ray waves after impact with atoms of low *at. wt.*

**Conarium.** Pincal body. Transparent larva of velella.

**Conation.** Mental effort.

**Concentration, ch.** Conc. of a solution is the *mass* of the *solute*—i.e., the content of the dissolved material per 100 grammes of *solvent*, or per vol., or in parts per million. The max. c. at any temp. is the

*coefficient of solubility.* *Psy.* Exclusive attention. The collecting in a definite zone of the cerebral cortex of nerve-excitations—a feature of the *conditioned reflex*. *Cf.* Irradiation.

**Concentric.** Having a common centre. *App.* vascular bundles.

**Conceptacle.** Cavity, containing reproductive els., antheridia and oogonia, in algal thallus opening to surface by an aperture, the ostiole. **Conception.** (1) Fusion of nucleus of spermatozoon with nucleus of ovum. (2) Brain processes whereby ideas are formed.

**Concha.** Any shell-like organ. External ear. **Conchiolin.** Organic base allied to *chitin*, containing c. 95 p.c. lime, and forming a part of the living membranous framework of the shells of molluscs. **Conchology.** Study of shells.

**Condensation.** (1) Process by which a vapour or a gas becomes liquid or solid either by cold—*i.e.*, withdrawal of heat—or by increase of pressure, or by both. (2) The linking of mols. with elimination of water—*e.g.*, glucose changes to cellulose, to glycogen, to maltose, or to sucrose by condensation. *Opp.* hydrolysis. *See* Pycnosis. (3) Crowding towards a centre. Union of atoms to form a compound of greater complexity and density—*e.g.*, formation of ozone,  $O_3$ , from oxygen,  $O_2$ . **Condenser, elec.** Insulated plates of metal for storing electric charges. *Phy.* Apparatus for compressing gases or for liquefying steam or other vapours.

**Conditioned reflex.** A tem-

porary, or acquired reflex—*i.e.*, a reflex which has to be learned and which, therefore, is *conditioned* by some new element.

The essential function of the analysers of the brain is to elaborate the c.r. which, at bottom, is an act of synthesis of the cerebral hemispheres. *Ex.* pouring of saliva into mouth on hearing a dinner-bell.

**Conductance.** Degree of *conductivity*. Conducting power. Reciprocal of resistance. The unit is *MHO* or Ohm spelt backwards.

**Conduction.** Transmission through a medium, the conductor. Transference of heat from particle to particle. *Cf.* Convection; Radiation. Transference of soluble matter throughout a pl. **Conductor.** A substance that readily conducts heat or elec. A substance permitting of free migration of electrons through it—*e.g.*, such as silver, copper, and salt water.

**Conduplicatio.** Estivation or vernalation in relation to leaves and petals. The folding of cotyledons so as to embrace radicle.

**Condylarthra.** Primitive, 5-toed, eocene, ungulate mammals. **Condyle.** Bony process for purposes of articulation—*e.g.*, the rounded head of thigh-bone which fits into the socket of hip-bone.

**Cone.** (1) *Per.* non-nervous optical els. in insect's eye—*A.*, eu-, exo-, pseudo-cone, etc. (2) Sensory el. in retina of diurnal vert. The cones, as opp. rods (*q.v.*), are the organs of discriminating and of colour vision. (3) A strobile, either carpellate (egg-bearing) or staminate (pollen-bearing) of pines, hence called *coniferae*.

(4) The solid generated by rotation of a right triangle about one of its "legs" as axis.

**Conervæ.** *Gen.* of filamentous thallophytes.

**Conformable strata.** Parallel strata.

**Confusing coloration.** Colour that differs according to whether a hunted an. is at rest or in motion and which therefore baffles the pursuer. *Ex.* running lizard shows bright yellow colour under its tail; when the an. suddenly stops the yellow colour disappears through lowering of tail.

**Congenital.** *Per.* a character present at birth. Such character is *not necessarily* blastogenic or present in germ-plasm, for it may have been acquired during intra-uterine development. **C. variations.** Blastogenic variations. Biologically these are usually intended to apply solely to intrinsic, in-born, germ-plasm variations not due to external influences operating on sperm-cell, egg-cell, or zygote, or post-zygotic embryo or foetus.

**Conglomerate.** Densely-clustered. Irregularly-grouped. Sedimentary rock composed of cemented pebbles. A mass of water-worn fragments united by some substance (carbonate of lime, silica, oxide of iron, etc.) in aqueous solution. *Cf.* Agglomerate.

**Conic sections.** The circle, ellipse, para-, and hyper-bola, all which curves are formed by differently-directed sections of a right circular cone by a plane.

**Conidiophore.** Conidia-bearing branch of hypha. Pycnidophore. **Conidiospore.** One

of the spores of a sporangium of conidiophore. **Conidium.** Exosporium. **Conidium.** Asexual spore formed by segmentation of mycelium or by break up of cell into brood-cell. **Gonidium.** Conidio-, Stylo-spore. Macro-, Stylo-conidium. Exosporium. **Conifer.** Cone-bearing tree. Pine. O. of Gymnosperms.

**Conjugant.** Conjugative cell. Gamete. **Conjugation.** Fusion, partial or complete, temporary or permanent, of 2 cells, with exchange of nuclear material and chromatin, or complete fusion of nuclei and chromatin.

In metazoan c. there is usually complete fusion of a small, active, free-swimming m. cell or spermatozoon, with a large, passive f. cell or ovum. At bottom c. is a form of nutrition, of *isophagy*. *Cf.* Assimilation. The less nutritive, smaller, "hungrier," more active m. cell seeks out, is engulfed by, yet finds sustenance in, the better-nourished, larger, and more quiescent f. cell, which, because of its replete state, is relatively inappetent and has less tendency to move towards the m. cell. Where c., as in infusoria, is only occasional and after many divs. of the cells, it confers on the conjugants rejuvenating effects. *Syn.* auto-, syn-gamy; zygosis.

**Conjunctiva.** Mucous membrane lining eyes and eyelids.

**Connate.** Firmly or congenitally united.

**Connective.** *App.* nerve-tissue between 2 ganglia; to mesoblastic tissue and intercellular substance in which fibres are developed. Tissue connecting two anther lobes.

**Consciousness.** State of awareness. Subjective phenomena evoked in brain-matter.

C. is an activity of associated cerebral cells possessing at a given moment a cert. optimal excitability concurrent with diminished, or ab-

source of, excitability of all remaining cerebral cells. *See* Reflex action.

**Consensual.** *App.* involuntary action correlated with voluntary action.

**Conservation of matter-energy.** The theory that the sum-total of matter and energy in the universe is constant, uncreatable, and indestructible.

One kind of energy is transmutable into another kind of energy, and one kind of matter into another kind of matter. Modern science tends to show that matter is, further, transmutable into energy, and conversely, that energy is transmutable into matter.

**C. of momentum.** The principle that the total linear momentum of a mass is the sum of the momenta of all its particles and that it remains constant in amount and direction despite all internal collisions and reactions of its parts.

**Consortium.** Compound thallus of lichens.

**Constant.** A numerical quantity that retains the same value under given conditions. *Opp.* variable. **C. current.** A unidirectional flow of electrons.

**Constellation.** An arbitrary group of fixed stars.

**Contabescence.** Abortion or atrophy of stamens.

**Context.** Layers between mycelium and hymenium. Fleshy part of mushroom.

**Contractile vacuole.** A fluid-filled cavity in cytoplasm which exhibits periodic contraction, causing expulsion of surplus water and waste products. The c.v. is a very primitive organ of excretion. *Syn.* contractile vesicle; pulsatile vacuole; pusule. *Cf.* Food vacuole.

**Convection.** Transference of heat through a mass of liquid by currents. *Cf.* Conduction.

**Convergence.** The acquirement by organisms of different groups of similar form, colour, organs, structure, or character, as a result of a similar mode of life, or similar environment, and not as a result of common ancestry. *Homoplasty.* *Ex.* white colour of polar an.; long hair of Tibetan an.

**Convolutions of brain.** A limit appears to be set to thickness of cortex of brain, further accumulation of cells during development and evolution being allowed for by *enlargement of the superficial area* which, in the limited skull-space, can be effected only by throwing it into folds and fissures; these are the c.

**Co-ordinate.** Each of a system of magnitudes used to fix the position of a point, line, or plane. *E.g.,* lines of latitude and longitude, are c. to fix a place on earth's surface. *Ab-scissa.* *Ordinate.* **Co-ordination.** Co-operative functioning of parts in normal sequence. Orderly combination of reflexes.

**Copepods.** Water-fleas. *Sub-cl.* of minute f.-w. and marine crustaceans.

**Copper, ch. el.** Cu. Metal. *At. no.* 29; *at. wt.* 63.57.

**Coprodæum.** Part of cloaca that receives contents of rectum. *Cf.* Urodæum. **Coprolite.** Fossil excrement. **Copro-phagy.** Dung-eating. *App.* beetles, etc.

**Copula.** Zygospor. Amboceptor. **Copularium.** Cyst enclosing gametocytes. **Copulation.** Coition.

**Coracoid.** Bone of shoulder-girdle; well developed in reptiles, birds, and lowest mammals, but rudimentary in man.

**Coral.** An organic sea-rock consisting mostly of calcium carbonate *plus* the organisms (actino-, antho-, hydro-zoa; madre-, mille-pora, etc.) that extract the salts from seawater. **Coralline zone.** Seazone from 90 to 240 ft. depth. *Cf.* Abyssal; Laminarian; Littoral.

**Corbicula.** Pollen-basket; a fringe of hair on tibia of bees.

**Corbula.** A phylactocarp or modified hydrocladium.

**Cordaites.** Large, primitive carboniferous conifers; an O. of Palaeozoic gymnosperms.

**Cordate.** Heart-shaped. *App.* leaves with rounded base notched for insertion of petiole.

**Cordite.** Explosive mixture of guncotton, nitroglycerine, and mineral jelly.

**Coriaceous.** Leathery. Skin-like. **Corium.** Deep skin-layer below epidermis. **Cutis.** Middle div. of hemi-elytra.

**Cork.** Tissue composing most of bark of woody pl. and mainly derived from phellogen of outer layer of cortex. **C.-cambium.** Phellogen. **C. cells.** Cells of stem overlying phellogen but underlying epidermis.

**Corm.** Fleshy, underground stem carrying a few scale-leaves. *Ex. crocus. Cf.* Bulb.

**Cormidium.** Group of zooids united on a stolon. **Cormo-phyte.** A pl. with stem and root. *Cf.* Thallophyte.

**Cornea.** Transparent covering of front of eye; also of each facet of compound eye.

**Corneous.** Horny. **Cornute.** Horned.

**Corolla.** Flower parts internal to calyx made up of whorl of petals surrounding stamens, carpels, stigma, anthers, etc. Inner perianth of floral envelope, often bright-coloured and sweet-scented to attract insects for fertilization purposes. *See* Gamo-, Poly-petalous; Epi-, Hypo-, Peri-gynous. **Corollifloræ.** *Sub.-cl.* of Gamopetalæ.

**Corona.** (1) A halo-like luminous appearance extending to millions of miles from the surface of the chromosphere, roughly, to about two solar diameters. (2) A luminous circle seen around sun or moon and caused by fog-droplets in upper atmosphere. (3) A silent or brush discharge of elec. from a conductor. (4) Any crown-shaped structure, such as surface of tooth. **C. radiata.** Layer of radially-disposed long cells surrounding mammalian egg. **Cert.** fibres in brain.

**Corpora amylacea.** Starchy concretions in brain. **Brain-sand.** *Acervulus cerebri.* **C. bigemina, C. quadrigemina.** Basal ganglia of mid-brain of mammals composed externally of white, internally of grey, matter. The upper pair of c.q. are connected with *vision* and are vestigial in the mole; the lower pair are connected with *hearing* and are highly developed in this an. The c.b. are the equivalent in fish, amphibia, reptiles, and birds of the c.q. of mammals; in the mammalian embryo they precede and evolve into the c.q. *See* Brain. **Corpus callosum.** One of three great commissural bands of nerve-fibres connect-

ing the right and left halves of brain of mammals. The ant. and post. commissures are composed of white matter, the middle of grey matter. *See* Brain. **C. luteum.** Yellow swelling on surface of mammalian ovary which arises at site of Graafian follicle whence an ovum has been discharged. Its secretion sensitizes lining-membrane of uterus so that it adapts itself to demands of egg, embryo, and foetus. It also increases size of mammary gland, but does not influence milk-secretion. *See* Pituitary. **C. striatum.** One of a pair of brain ganglia which act as a highway for nervous impulses coursing between higher and lower nerve centres. **Corpuscle.** (1) Cell, especially a blood-cell. (2) An electron.

**Correlation.** Similarity of relationship. Co-variation. Interdependence of characters.

Mutual dependence of one organ on another. *Ex.* heavy antlers of stag entail enlarged neck muscles. The organs are not necessarily in the same individual. *Ex.* large-headed m. in a race entail large-hipped women.

**Cortex.** (1) Outer, protective part of a pl. or of an organ. Rind. Stem tissue external to endodermis but internal to epidermis. It is the cortex that forms the cork-cambium or phellogen and bark which together prevent escape of water and which, dead, form the outer, protective, scaly bark. (2) Grey matter. The outer, grey, layer of nerve-cells overlying the inner, deeper, layer of nerve-fibres, the white *medulla*. The brain cortex evolves from the "mantle," "*pallium*," or wall of

the cerebral vesicle and is the physical basis of thought and consciousness. *See* Brain. (3) Outer part of adrenal and kidney.

**Corymb.** A flat-topped flower-cluster. A racemose inflorescence in which lower and outer pedicels are longer than upper and interior ones so that all flowers of the cluster, though on stalks springing from different levels, are at same level. *Ex.* candytuft. *Cf.* Cyme.

**Cosecant.** Secant of complement of angle or arc. **Cosine.** Sine of complement of angle or arc.

**Cosmic.** *Per.* universe. **C. rays.** Photons or rays of energy (radiant energy) of extremely short w.-l.,  $5 \times 10^{-12}$  to  $20 \times 10^{-12}$  cms., extremely high freq.,  $15 \times 10^{22}$  to  $59 \times 10^{22}$  per sec., and of great penetrating power, 200 ft. water or 16 ft. of lead.

Their origin is held by some to be in the union of electrons and protons (*q.v.*) in the synthesis of els. in nebulae far outside the Milky Way. Of the total radiation-energy received on earth from *all* the stars (sun excepted) one-tenth part consists of c.r. Every second these c.r. break up 20 atoms in each cub. in. of air at earth's surface and disintegrate hundreds of thousands of atoms in our bodies. It is c.r. that discharge the most carefully-insulated electrically-charged body, and that ionize the upper atmosphere. The energy of c.r. is relatively enormous. A *quantum* of c. radiation contains 0.002 erg, as compared with 0.000,000,000,002 erg for a quantum of heat radiation. (One erg represents the energy expended in lifting 1/56,000 oz. through a vertical height of 1 in.). The energy of a c.r. may also be expressed as eq. to  $10^6$  to  $10^{11}$  electron-volts. Some authorities regard the c.r. as *positive electrons*.

**Cosmogen.** *Syn.* cosmoplasma. Hypothetical prim-



ordial substance from, and to which, electrons, protons, atoms, etc., arise and return. **Cosmo-genesis, -gony.** Origin and evolution of the universe. **Cosmology.** Study of the universe. **Cosmoplasma.** Cosmogen. **Cosmos.** The universe. *See* Chaos. *See* S.L.

**Costa.** Rib. Ridge.

**Cotangent.** Tangent of complement of angle or arc.

**Coterminous.** Co-extensive. Of similar distribution.

**Cotyledon.** Primary leaf of seedling tree or flowering pl. Seed-leaf. Young leaf of seed-embryo. First leaf of dividing oospore of prothallus. Patch of villi on mammalian placenta. *See* Di-, Mono-cotyledon. **Cotylloid.** Cup-shaped.

**Coulomb.** Unit of elec. quantity. Quantity of elec. which a condenser of one farad capacity holds when its potential is raised from zero to 1 volt. Amount of elec. transferred in a silver-plating solution of silver nitrate every time that 0.001118 gramme of silver is deposited on cathode. Amount of elec. carried in one sec. by one ampere, or that is conveyed in 1 sec. by current produced by E.M.F. of 1 volt acting against 1 ohm. The c. is  $= 6 \times 10^{18}$  electrons, or about  $2.06 \times 10^9$  E.S.U.

**Coverts.** Feathers covering quill bases. Tectrices.

**Coxa.** Segment by which leg of arthropods articulates with body. **Coxal glands.** Paired glands the ducts of which open over coxa. Slime-glands of peripatus.

**Crampon.** Aerial "root" affording support. *Ex.* ivy.

**Cranial.** Towards head or

front. **Craniata.** Skull-bearing vertebrates. *See* Classification. **Cranium.** Skull.

**Cream of tartar.** Potassium bi-tartrate.  $\text{KHC}_4\text{H}_4\text{O}_6$ .

**Creat-, creatin-ine.** Nitrogenous substances,  $\text{C}_4\text{H}_9\text{N}_3\text{O}_2$  and its derivative  $\text{C}_4\text{H}_7\text{N}_3\text{O}$  in vert. muscle, urine, and brain.

**Creative evolution.** (1) Designed ev. as *cf.* d. a mechanically-ordered one. Emergent ev. (2) Combinations and transformations of hereditary units in germ-cells whereby new structures and functions, not present as such in germ-cells, appear.

**Cremocarp.** A schizocarp with 2-seeded fruit, each seed in one carpel (mericarp), the pair of carpels being suspended by a carpophore and splitting apart on maturity.

**Crenate.** With rounded, notched margins. **Crenulate.** Minutely crenate.

**Creodonts.** Primitive eo-cene-oligocene mammals foreshadowing modern carnivora. **Creophagy.** Flesh-eating.

**Cresol.** Coal-tar extract.

**Creosote.** Complex mixture of phenols and ethers obtained by wood-distillation.

**Cretaceous.** *Per.* chalk. *Geo.* period of mesozoic above jurassic, below eocene. *See* Comanchean.

**Cretinism.** Condition (usually congenital) caused by deficient thyroid secretion (lack of iodine) and characterized by stunted growth and idiocy.

**Cribellum.** Sieve-like plates in spiders and insects forming part of spinning apparatus.

**Cribriform.** Sieve-like.

**Crinoids.** *Cl.* of echinoderms, including sea-lilies.

**Critical angle.** Least angle

of incidence at which total reflection of light occurs. **C. point.** A point of transition—*e.g.*, point at which gas becomes liquid. **C. temperature.** Temp. above which a *fluid* cannot exist as such—*i.e.*, either as a liquid or as a vapour. *E.g.*, the c.t. of water is 365° C. See Temperature.

**Cromagnon man.** Remains discovered in Gower, S. Wales, and Dordogne, in France. Flourished in magdalenian (late pleistocene) days *c.* 12,000–9,000 B.C., succeeding aurignacian-solutrean man and preceding capsiañ man. Good artist and stone- and bone-worker. Swift-footed as *cf.* *c.* Neanderthal man.

**Crookes layer.** A layer of vapour separating a mass of liquid in the spheroidal state from a hot metal.

**Crop.** Part of insect digestive tube between cesophagus (*q.v.*) and gizzard in which food is stored. Enlargement of cesophagus of birds. Region of annelid gut behind pharynx. Ingluvies.

**Cross.** To mate *m.* and *f.* individuals of different breeds or of separate pl. **C.-breeding.** **C. fertilization.** Reversing sexes of 2 varieties usually mated. *Ex.* *m.* ass and *f.* horse give comparatively infertile *mule*; *f.* ass and *m.* horse give the more fertile *hinny*; *m.* Californian walnut and *f.* black walnut produce sterile but very fast-growing trees, while *m.* black walnut and *f.* Californian yield trees that grow slowly but produce exceptionally fine and large nuts. *Syn.* xenogamy. See *Allogamy*; *Hybridization*; *Mendelism*.

**Crossing over.** Interchange between homologous chromosomes of inheritance factors (genes) at synapsis.

**Grossopterygii.** Group of fishes, mostly extinct (but of which polypterus is a living example), linking elasmobranchs on the one hand with teleosts and dipnoi on the other. Terrestrial verts. probably arose, *via* the amphibia, from an early member of this group.

**Crural.** *Per. leg.*

**Crustacea.** *Cl.* of aquatic, gill-breathing, arthropods with many appendages and 2 pairs of antennæ. *Ex.* crab; lobster. A few are adapted to terrestrial life. *Ex.* sand-hopper; wood-louse. Crustacea probably evolved from the trilobites (*q.v.*). There are 8000 species.

**Cryohydrate.** A substance which, when in solution, solidifies as a whole. **Cryohydric point.** The temp. at which a cryohydrate solidifies. *Ex.* — 22° C. for sodium chloride, — 55° C. for calcium chloride. **Cryoscopy.** Determination of molecular weight (also of osmotic pressure) by observation of the temperature at which the liquid (and solvent) freeze.

**Cryptic.** Protective coloration (*q.v.*) for concealment. *Cf.* *Sematic.* **Cryptocarp.** Sporophyte phase of red algae. **Cystocarp.** **Cryptogams.** Pl. with concealed reproductive organs and no true flowers. *Syn.* cryptophytes. *Cf.* Phanerogam. **Cryptogams,** cellular or vascular. Pteridophytes. Bryo-, thallo-phytes. **Cryptomere.** Hidden recessive, hereditary factor. **Cryptoneurous.**

Without definite nervous system. **Cryptophyte.** Cryptogam. **Cryptorchism.** Condition where testes have not descended from abdomen. **Cryptorhetic.** Endocrinal. **Cryptostoma.** Non-sexual conceptacle. **Cryptozoic.** Living in concealment. Light-shunning.

**Crystal.** (1) Quartz. (2) An aggregate of molecules with a geometrical structure and form enclosed by symmetrically-arranged plane faces. Crystals are div. into: (1) isometric; (2) tetragonal; (3) hexagonal and rhombohedral; (4) orthorhombic; (5) monoclinic; (6) triclinic. **C. rectifier** (wireless). Crystalline minerals, such as molybdenite, galena, etc., which conduct elec. current unidirectionally only and so convert a two-way into a one-way current. **Syn.** detector. **Crystallin.** Globulin of eye-lens. **Crystalline.** *Per.* substance the mols. of which, under given conditions, have power of arranging themselves symmetrically to produce a geometrical form. **Crystalloid.** A substance which, in solution, readily diffuses through an. or pl. membranes. A protein crystal. *Cf.* Colloid.

**Ctene.** Swimming-plate of ctenophore. **Ctenidium.** Gill. One of the respiratory and nutritive organs of lamellibranchs. A ciliated, comb-like gill-plate. Comb-like row of spines in cert. insects. **Ctenoid.** Comb-like. **Ctenophora.** *Cl.* of non-colonial pelagic coelenterates with comb-like swimming-plates. **Syn.** comb-jellies. **Ctenophore.** Swimming-plate (*q.v.*).

**Cube.** (1) Third power of a number. (2) Regular solid with 6 = sq. sides.

**Cubital, Cubitus.** *Per.* ulna, elbow, forearm, primary vein of insect wing, etc.

**Cucullate.** Hooded. Cowled. *App.* hood-shaped petals, sepals, etc.; or to hood-shaped prothorax.

**Cud.** Food brought back into mouth from first stomach of ruminants for re-chewing.

**Culm.** Jointed stem of grasses. **Haulm.** *Geo.* deposit of conglomerates, sandstones, shales, etc.

**Culture, bio.** (1) Artificially-cultivated bacteria, etc. (2) *Geo.* An epoch of geological time designating man's attainments in food-getting, shelter-construction, clothing, ornamentation, fire-making, language, music, transport, plant cultivation, animal domestication, tool- and weapon-making, artistry, sculpture, etc. *Ex.* Acheulian c. Magdalenian c.

**Cumulo-cirro-status.** Thunder-cloud. **Cumulus.** Wool-pack cloud; a rounded, hemispherical-shaped cloud of 7000 ft. air-level.

**Cuneiform.** (1) Wedge-shaped. (2) Three distal bones of tarsus. (3) Sumerian inscriptions.

**Cupr-ic, -ous.** *Per.* copper.

**Cupule.** A cup-shaped organ —e.g., involucre of oak. **Ascoma.** Corolla. Sucker. **Ace-tabulum.**

**Curare.** Arrow-poison of S. American Indians extracted from pl. *strychnos*.

**Current, elec.** Flow of electrons through a conductor (wire) resulting from a differ-

ence of potential. **C.-density.** Amperes div. by cross-sectional area of conductor. **C. unit.** *Abs.* ampere or  $1.0363 \times 10^{-5}$  Faraday per sec.

**Cursorial.** Adapted to running and walking.

**Cusp.** Prominence or point; especially one on a tooth.

**Stylus.** **Cuspidate.** Having cusps. **App.** teeth and leaves.

**Cuticle.** Skin. Integument. Epidermis. Skin-pellicle.

**Scarf-skin.** Outer skin. Single layer of cells of epidermis forming thick outer wall of pl. stem.

*See* Periplast. **Cutin.** Substance allied to cellulose in external layers of thickened epidermal cells of pl. **Cutis.** Corium. Skin.

**Cuvierian organ.** Sticky, glandular mass in holothurians (sea-cucumbers) which is ejected from cloaca when an. is threatened. The material sticks to all animals *except* holothurians, and entangles them.

**Cyanide.** A cyanogen (*q.v.*) compound.

**Cyanogen.** A poisonous gas composed of carbon and nitrogen (CN)<sub>2</sub>; it is the univalent radicle of prussic acid, HCN.

**Cyano-phyceæ.** Blue-green algæ. **Cyanophyll.** Blue-green colouring matter of pl.

**Cyanosis.** Blue coloration of skin due to imperfect blood aeration.

**Cyathozoid.** A primary or degenerate zooid of tunicates.

**Cyathus.** Cup-shaped organ. **Cupule.**

**Cycads.** Ancient, mesozoic O. of tropical gymnosperms allied to pteridophytes and possessing a few modern representatives. **Cycado-filices.**

Palæozoic pl. intermediate between cycads and ferns, descendants of primofilices and ancestors of cycads or progiosperms.

**Cycle.** Elec. current or E.M.F. which, starting at zero, rises to a max., falls to zero,

rises to a max. in reverse direction, and again falls to zero;

arrival at the second zero completes a half, at the third zero, a whole cycle. *See* Frequency.

**C. of life.** (a) The individual, or *ontogenetic*. (1) *Epacme*, or period of growth, div. into embryonic or *nepionic* and adolescent or *neanic*;

(2) *acme*, or period of max. development, the adult or *ephebic* stage; (3) *paracme*, or period of decline, the senescent or *gerontic* stage.

(b) The racial, or *phylogenetic*, comprising (1) the *phylo-nepionic* or *-neanic*; (2) the *phylo-ephebic*; (3) the *phylo-gerontic*.

**Cycloid.** One of the curves (common, curtate, prolate) traced in space by a point on the radius, or its extended line, of a circle rolling in a plane.

**App.** fish scales with smooth margins and concentric lines of growth.

**Cyclop-ean, -ism.** Having a single median eye.

**Cyclops.** (1) A copepod or minute crustacean with single median eye. (2) Monstrous human foetus with two eyes fused in a single median socket.

**Cyclosis.** Pl.-cell circulation.

**Cyclospermous.** **App.** pl. embryo that embraces endosperm.

**Cyclospindyl-ic, -ous.** Most primitive type of vert. in which a calcified cylinder surrounds notochord, as in shark.

**Cyclostomata.** Most primitive verts. numbering some 15 species.

Chordata with single nostril,

persistent notochord, round, jawless, suctorial mouth. *Bz.* lamprey.

**Cyme, Cymose.** Flower cluster. An inflorescence in which primary axis ends in a flower while from each side of this primary axis a secondary axis branches off to terminate in its turn in a flower, and a tertiary axis branches off from the secondary and ends in a flower. *Cf.* Racemose; Corymb.

**Cynodonts.** Primitive triassic reptiles with dog-like teeth. Their retention of the quadrate bone between skull and jaw, and the fact that the latter is made up of several bones, shows that they were not true mammals.

**Cyphonautes.** Free-swimming bivalve larva of polyzoa. **Cyst.** Air vesicle. Liquid-filled vesicle. Bladder. Spore-sac. Pouch. Sac, especially when abnormally present as a dermoid cyst. **Cystenchyma.** Large-celled tissue in sponges. **Cystencyte.** Cell of cystenchyma of sponge. **Cystocyte.** **Cysticereoid, -ous.** Larval bladder-worm stage of tape-worms. **Cysticolous.** Dwelling in a cyst. **Cystidium.** Distended cell in hymenial layers of fungi. **Cystoarian.** More evolved type of gonads in fishes (teleosts), wherein they are enclosed in coelomic sacs. *Cf.* Gymnoarian. **Cystocarp.** **Cryptocarp.** **Cystocyte.** **Cystencyte.** **Cystolith.** A small limy concretion.

**Cytase.** A cellulose-dissolving enzyme.

**Cytaster.** Star-shaped achromatic figure including aster and attraction-sphere. **Aster.** *Cf.* Karyaster.

**Cyte.** Cell. **Spermatocyte,**

**oocyte, etc.** **Cytoblast.** Cell-nucleus. **Bioblast.** **Biophor.** **Protoplast.** **Cytochromatin.**

Chromatin exclusive of that in nucleus. **Cytosome.** **Cytochrome.** Iron-containing pigment concerned with intracellular respiration, especially of bacteria. Probably a precursor of hæmoglobin. **Cytochylema.** **Cytolymph.** **Cyto-coccus.** **Zygote nucleus.**

**Cytode.** Non-nucleated cell. *App.* protoplasmic unit more primitive than a cell. **Cyto-diæresis.** Cell-conjugation.

**Cyto-, syn-gamy.** **Mitosis.** *App.* more especially to the processes taking place in cytoplasm as opp. to nucleoplasm. **Cytogamy.** **Cytodiæresis (q.v.).** **Cytogenesis.** Origin and formation of cells. *See* Plasmogeny.

**Cytoglobin.** A nucleo-protein which retards blood-coagulation. **Cytokinesis.** All changes eventuating within cell during div. **Cytology.** Study of cells. *Cf.* Protistology. **Cytolymph.** **Cyto-, en-chylema.** The more fluid part of cytoplasm as opp. to cyto-reticulum. **Cytolysin.**

A substance initiating **Cytolysis.** Cell-dissolution. **Cytomere.** Cell-part or fragment. Non-nuclear part of spermatozoon. Daughter-cell of schizont. **Cytomicrosome.** Microsome within cytoplasm. Extracellular chromatin granule. *Cf.* Nucleo-microsome. **Cytomitome.** **Cytoreticulum.** **Cytomorphosis.** Series of changes going on in a cell or in successive generations of cells.

**Cyton.** Cell. **Neuron.** **Cytophagy.** Feeding or living on cells. **Phagocytosis.** **Cytoplasm.** **Cytosome.** Cell-protoplasm; more especially its

ground-substance as *opp.* to the granular material. Protoplasm of "body" of cell as *opp.* to that of nucleus. See Ecto-, Endo-, Karyo-, Nucleo-, and Tropho-plasm. **Cytoproct**, -pyge. Cell anus. Aperture in unicells for discharge of waste-products. Cf. Cyto-stome. **Cytoreticulum**. Cytoplasmic network. Spongio-plasm. **Cytomitome**. The more solid, as *cf.* *c.* more liquid cell contents. Cf. Cyto-lymph. **Cytosome**. Cell-body as *opp.* to cell-nucleus. Cytoplasm. Also *app.* cytochromatin and chromosome. **Cyto-**

**stome**. Cell-mouth. Aperture in unicell for intake of food, etc. Cf. Cytoproct. **Cytotaxis**. Attraction or repulsion exercised by one cell on another. **Cytotropism**. Cell chemotaxy. **Cytothesis**. Cell-repair. **Cytotoxin**. Any substance poisonous to cells. A special cell-poison in blood-serum. **Cytotropism**. **Cytotaxis**. **Cytozoic**. Living *within* a cell. **Per. cytozoon**. Cell-parasite. A bacterium, sporozoan, trophozoite or other micro-organism living inside a cell. **Cytula**. Cell, especially a fertilized ovum or zygote.

## D

**Dactylopodite**. Distal segment of crustacean limb. **Dactylopores**. Apertures in corals through which dactylozoids are thrust. Cf. Gastropores. **Dactylozoid**. The long, mouthless (usually tentacled) individual of a hydrozoan colony which seizes prey. See Zooid. *Syn.* hydrocyst; palpon; sarcostyle.

**Dalton**. Mass unit, being the  $1/16$  of mass of O atom or  $1.65 \times 10^{-24}$  gramme. **D.'s law**. *Syn.* Charles's law. Vol. occupied by a given quantity of gas varies directly as its absolute temp., provided pressure (*p*) remains constant.

1000 c.c. of air at 0° C. heated to 1° C. (with *p.* constant) becomes 1003.665 c.c.—*i.e.*, increases by  $1/273$  of its vol. This increase for each degree is the *coefficient of expansion*. If the gas be cooled from 0° C. to -1° C. the vol. decreases by  $1/273$ . The law fails at *very low temps.*, otherwise at -273° C. a gas would have no vol.!

**Damping**. Gradually de-

creasing the amplitude of E.M.F. oscillations, waves, etc.

**Dart-sac**. An eversible part of the f. gastropod reproductive organs which contains blade-like daggers of calcium carbonate called "love-darts." These are shot by one snail into the body of another in which they arouse sexual excitement preparatory to mating.

**Darwin's tubercle**. Eminence near top of helix of human ear—the relic of the former point of the ear. **Darwinian variations**. Continuous, slight variations. Cf. Mutation. See Darwinism. **Darwinism**. Theory that *Natural selection* (*q.v.*) favours the survival of those individuals whose slight variations (always present) from parents render them better adapted to their environment, and that by the long-continued operation of this process organisms of widely-differing groups, as well as

new species, have arisen from common ancestors; in short, that the *origin of species* is traceable to "natural selection" working on slight variations and eliminating those less adapted for survival under existing conditions.

**Dasyptedes.** Birds with down-covered young. **Dasyphyllous.** Having hairy leaves.

**Daughter-cell.** First generation cell-offspring—*i.e.*, either of the two cells (irrespective of sex) into which a parent—or mother-cell—divides. *See* Chromatid; Centrosome.

**Daun.** The third minor ice-advance during the general retreat of the Würm glaciation.

**Day, astronomical.** Mean noon to mean noon commencing 12 h. after the civil d. (*q.v.*). **D., civil, or D., mean solar.** The 24-h. day of 86,400 secs. **D., sidereal.** Actual time of one earth-rotation ( $= 360^\circ$ )—*i.e.*, 86,164 secs. **D., true solar.** Interval between two successive transits of sun across a meridian. Its length varies according to speed of earth's revolution, but it averages 86,404 secs.

**Dead centre.** Position of a crank when the turning moment on it is zero.

**Dealation.** Wing-shedding (ants).

**Deamination.** Extraction of amino-group ( $\text{NH}_2$ ). *Ex.* conversion in liver of ammonia compounds into urea.

**Death.** Cessation of life (*q.v.*).

Biologically this is a gradual process, for, though the body as an *organized whole* may have ceased to function, parts of it may be still functioning. Hence, strictly, d. is cessation of *all* vital functions—*i.e.*, of the

functions of each of the body's *many* trillions of cells.

**Death-watch.** A beetle (*anobium*) in old wood, that at times makes a ticking sound to attract its mate.

**Decapod.** (1) O. of crustaceans (shrimp, crab) with *ten* thoracic legs. (2) Sub-o. of *ten*-armed cephalopods (cuttlefish). **Decaploid.** *See* Polyploid.

**Deciare.** Ten sq. metres; 11.96 sq. yds. **Decibel.** One tenth of a bel (*q.v.*).

**Decidua.** The mucous membrane of uterus which is first hypertrophied and then shed during and after menstruation and parturition. The *D. basalis* (*serotina*) supports and nourishes ovum and forms the placenta. *D. reflexa* surrounds the fertilized ovum. *D. vera* covers wall of uterus. **Deciduate.** Shed periodically. A higher *placental* mammal. **Deciduous.** Falling, or shedding, at end of growing period—as of leaves, and milk-teeth (*q.v.*). *Syn.* caducous. Not evergreen.

**Decillion.** Unity followed by 60 (England  $10^{60}$ ) or by 33 (America and Continent  $10^{33}$ ) zeros.

**Declination.** Angular distance from celestial equator measured N. or S. on hour-circle. Angle made by magnetic needle with geographical meridian—*i.e.*, its vertical deviation from *true* N.

**Decomposition.** Putrefaction; decay. Resolution of a compound into simpler bodies. *Cf.* Dissociation. *See* Heat of d. **Decomound.** *Bot.* having divs. which are themselves compound; having complete monopodial branching.

**Decurrent.** Extending downwards. Having stipules united to, or leaf-base closely applied to, stem.

**Decussation.** Crossing and union of nerves, fibres, veins, leaf-veins, etc. Having alternating paired leaves with each pair at right angles to pair above and pair below. Inter-crossed.

**Deduction.** Reasoning from general principles to particulars or to other general principles. In d. the conclusion is certain if premises are sound. *Cf.* Induction.

**Defaecation.** Eliminating impurities; voiding excrement.

**Degeneration.** Devolution; retrogressive evolution. Simplification of an organized structure by reduction of parts.

**Deglutition.** Act of swallowing.

**Degree.** A div. A part per cent. Rank as defined by sum of exponents. One 360th part of a circumference, or 60 minutes.

**Dehiscence.** Bursting open along a definite line, as of a pod along a suture. *Cf.* Indehiscence.

**Deliquescence.** Becoming liquid through absorption of moisture. Fine ramifications.

**Delirium.** Temporary brain-functioning disorder, with hallucinations.

**Delta.** Fan-shaped tract of land at mouths of large rivers due to deposition of solids.

**Delusion.** A judgment not accepted by most persons of same class, education, race, and period. Self-deception from want of knowledge. A false impression. *Cf.* Illusion. *See* Perception.

**Demersal.** Immersed. *App.* e.g., to eggs that sink in water as *cf.* c. pelagic eggs that float. *Syn.* dimersal.

**Dendrite.** (1) A branching nerve-cell process other than the axon. *Syn.* Dendron. (2) Tree-like crystal. *See* Axis-cylinder.

**Dendron.** *Syn.* Dendrite (*q.v.*).

**Denitrifying bacteria.** Bacteria which reduce (*q.v.*) nitrates.

**Density.** Closeness with which particles are packed.

D. depends on both wt. of mols. and on their mutual proximity; it is the mass of the unit vol. of a substance. *Specific Gravity* is in proportion to d. and is its measure—e.g., the ratio of the d. of iron to the d. of water is its *relative d.* or *sp. gr.* The d. of water is measurable by the no. of lbs. in a cub. ft.; this amounts to 62.5. On this scale the d. of iron is 441, for 441 lbs. of iron or 62.5 lbs. of water occupy a cub. ft. C.g.s. A substance of which a vol. of 1 c.c. has a mass of 1 gramme has unit d.; thus, 1 c.c. of water at 0° C. weighs 0.999878 gramme, and this figure (approximately unity) represents its d. One c.c. of ice at 0° C. weighs 0.91752 gramme and this is the d. of ice at 0° C. At 15° C. 1 c.c. of water weighs 0.999154 gramme, and this is its d. at 15° C. D. is thus an *absolute* quantity; *sp. gr.* a *relative*. The d. of a gas is the mass of 1 c.c. of it expressed in grammes. For air at 0° C. and 760 mm. p. the d. is 0.001293 gramme per c.c. The d. of a vapour at temps. a few degrees above b.p. (when it obeys gaseous laws) is proportional to its molecular wt. If d. of air is taken as 1.0, that of H is 0.0693, and for all other gases and superheated vapours the d. is 0.0693 × molecular wt.

**D. of earth.** This is 5.5 times greater than a globe of same size consisting entirely of water. d. of earth increases with depth, being 4.5 at 600 miles, 10.0 at 1800 and 12.5 at 4000 miles (the centre). **D. of ocean.** *Average* sea-water has a d. of 1.0275, pure water being 1.0.



**Dental formula.** An expression of the no. and type of teeth. *Ex.* taking man, where *i*, *c*, *b*, and *m* stand respectively for incisor, canine, bicuspid, and molar, the formula is:

$$i \frac{2-2}{2-2}; c \frac{1-1}{1-1}; b \frac{2-2}{2-2}; \\ m \frac{3-3}{3-3} = \frac{16}{16} \text{ or a total of } 32$$

in both jaws. **Dentine.** Hard, dense, bone-like material below enamel of tooth (*q.v.*).

**Depolarize.** Preventing polarization (*q.v.*) by removing H or other substance that has accumulated on an electrode.

**Derm, Derma.** Sensitive layer of skin beneath epidermis. *Syn.* corium; cutis; dermis. **Dermal bone.** A skin bone (reptiles); a bone developed in *membrane—i.e.*, not in cartilage. **D. teeth.** Minute bony teeth in skin of sharks, etc. (shagreen). **Dermatogen.** Embryonic layer which gives rise to pl. epidermis. Outer cell-layer of terminal buds and root-apex (*q.v.*). **Dermatome.** Skin segment of embryo. **Dermatoplasm.** Formative protoplasm of cell-wall. **Dermatoplast.** Cell-walled protoplast. **Dermatopsy.** Having skin-cells (insects) specialized for light stimuli. **Dermatosome.** A plasome. A fundamental cell unit. **Dermis.** Derm (*q.v.*). **Dermoblast.** Layer of mesoblast forming skin. **Dermoskeleton.** *Syn.* exoskeleton (*q.v.*).

**Deserticolous.** Inhabiting deserts.

**Desmigrate.** An ant intermediate between soldier and worker.

**Desmid.** A single-celled (rarely many-celled) f.-w. alga without siliceous skeleton. *Cf.* Diatom.

**Desor.** *See* Type.

**Desquamation.** Shedding of skin in flakes.

**Detector.** Crystalline rectifier (*q.v.*).

**Determinant.** A collection of biophors representing a heredity factor. **Determinate.** Cymose. *Per.* cleavage. *App.* inflorescence with primary axis terminating early with a flower-bud. **D. variation.** *See* Orthogenesis. **Determinism.** The teaching that things are as they are as a result of necessity, and that *all* acts of the will result from *determining causes* of some nature and therefore cannot strictly be free. *Opp.* free-will.

**Detonation.** Very rapid and violent decomposition set up by wave-motion. *Cf.* Combustion.

**Deuterium.** D. Isotope of H of mass 2.01367. Heavy water is D<sub>2</sub>O. **Deuterogamy.** Digamy (*q.v.*). **Deuteron.** The nucleus of deuterium (*q.v.*) composed of a proton + neutron or a positron + 2 neutrons. **Deuteroplasm.** Deutoplasm (*q.v.*). **Deuterotoky.** Parthenogenetic reproduction of m. and f. *Cf.* Arrhen- and Thelyotoky. **Deuterozoid.** A secondary zoid.

**Deutoblasts.** Amceoid bodies within zygote. *Cf.* Protoblast. **Zytoplasm.** The lifeless precursor of formative protoplasm of ovum. **Deutero-, Meta-plasm.** Yolk. **Deutosomes.** Granules thrown out of nucleus into cytoplasm.

**Devolution.** Passage from

the more to the less complex. Retrograde ev.

**Devonian, geo.** A period of middle palaeozoic following Silurian and preceding Mississippian or earliest carboniferous.

**Dextrotropism.** Curling from left to right. *Syn.* dextrotropism. *Opp.* sinistrotropism.

**Dextrin.** Carbohydrate intermediate between starch and sugar. **Dextrorse.** Growing spirally from left to right. *Syn.* dextrogyrate. *Opp.* sinistorse (*q.v.*). **Dextrose.** Grape-sugar.  $C_6H_{12}O_6$ .

**Diadelphous.** Having stamens united by their filaments into two bundles. **Diageotactism, -tropism, -tropy.** A response to gravitation in which a main axis is placed at right angles to line of gravitation. *See* Geotropism. *Ex.* horizontal growth of leaves, twigs, branches, rhizomes, roots, etc. *Syn.* diageotropy; diageo-, exo-tactism; exo-tropism.

**Diaheliotropism.** Response to light in which the long axis of an organism or an organ is oriented at right angles to incident rays of light. *Syn.* diaphototropism. *See* Heliotropism.

**Diakinesis.** Last stage of meiotic prophase in which chromosomes are in form of double rods.

**Dialyphyllous.** Having separate leaves. **Dialysis.** Separation of crystalloid mols. from colloid particles. *Cf.* Osmosis.

**Diamagnetic.** Having magnetic permeability less than that of a vacuum (= unity). *Opp.* paramagnetic. *Ex.* anti-mony is diamagnetic—*i.e.*, it

is repelled (in air) by a magnet.

**Diandrous.** Having two free stamens.

**Diapedesis.** Passage of leucocytes out of, or into, a blood-vessel.

**Diaphototropism.** Diaheliotropism (*q.v.*).

**Diaphragm.** Any thin lamina. Polychæt buccal muscle-sheet. Muscle-tendon partition in mammals separating thorax from abdomen; it aspirates air into lungs and is the cause of hiccup when spasmodically contracting.

**Diaphysis.** Shaft of a bone; prolongation of axis or of shoot. *Cf.* Epiphysis.

**Diaschistic.** *App.* bivalents that split transversely at first div. or to a tetrad that divides once transversely and once longitudinally. *Syn.* pseudomitotic. *Opp.* anaschistic.

**Diastase.** Enzyme changing starch to sugar. *Syn.* amylase. *See* Catalysis.

**Diastem.** An intervening space. Div. plane of a cell during mitosis. Space between sets of teeth.

**Diaster.** Double group of chromosomes during anaphasis.

**Diastole.** Phase in heart's action when muscle is relaxed and the cavity is becoming distended with blood. Dilatation of a vacuole. *Opp.* systole.

**Diathermancy.** *App.* media that readily transmit infra-red radiations. *Ex.* a vacuum or a plate of rock-salt is diathermanous. *Opp.* athermancy.

**Diathesis.** Constitutional aptitude or susceptibility.

**Diatom.** Unicellular—sometimes multicellular—f.w. and marine algæ with siliceous cell-walls. *Cf.* Desmid.

**Diatropism.** Orientation at right angles to line of action of stimulus.

**Dibasic.** Having *two* replaceable univalents (a H or other univalent atom, or basic hydroxyl).

**Dichasium.** A cymose inflorescence in which two branches are at same level.

**Dichlamydeous.** Having calyx and corolla.

**Dichogamy.** Hermaphroditism (*q.v.*) in which ova and sperms are produced at different times so that self-fertilization is avoided and cross-fertilization ensured. As a rule, both in pl. and an., the m. organs (stamens; testes) ripen before the f. (carpels; ovaries) the condition being known as *protandrous d.* Rarely, the order is reversed, the condition being known as *protogynous d.* See Andro-, Proto-gynous; Hermaphroditism.

**Dichoptic.** With well-separated, non-coadapted eyes. Cf. Holoptic.

**Dichotomy.** Bifurcation; regular div. into pairs.

**Diclinous.** Having stamens and pistils on separate flowers, but staminate and pistillate flowers on same pl. See Germiparity; Unisexual.

**Dicotyledons.** *Sub-cl.* of angiosperms. Pl. with flowers usually in multiples of 5, with reticulate leaves, and which produce *two* seed-leaves. Cf. Monocotyledon.

**Dictyo-dromous, -genous.** With netted-veined leaves.

**Dictyosome.** An el. of a germ-cell or of a golgi apparatus (*q.v.*).

**Didelphia.** Marsupials with

double uterus and no placenta. **Didiploid.** An autotetraploid. See Autopolyploid.

**Didymium.** Neo- and praseo-dymium (*q.v.*).

**Didymous.** Paired; twin; two-fold. **Didynamous.** Having two long and two short stamens.

**Dielectric.** An insulating substance. A medium admitting of passage of lines-of-force (by induction or disruptive discharge) of an electrostatic field thereby making it a seat of strain. Cf. Anelectric.

**Diencephalon.** The between-brain or thalamencephalon.

**Differentiation.** Specialization. Concentration of function in some particular zone. The structural result of physiological div. of labour (*q.v.*). **Integration.** Increase of complexity. Advance from the relatively homogeneous to the relatively heterogeneous.

**Diffraction.** Phenomenon due to prevention of the wave-front of a light-wave coming to a focus. This occurs when a wave passes by a sharp edge or through a narrow slit or is reflected from a delicately ridged surface.

**Diffusion.** Equalization of the physical state of a solution or mixture. Production of a homogeneous out of a heterogeneous mixture of gases or liquids due to the movements of mols. Process whereby a solute spreads uniformly throughout a liquid in opposition to gravity. Cf. Osmosis. Process of reflection of light by a rough surface, or of transmission of light through a translucent medium.

**Digamy.** Having m.-pro-

ducing and f.-producing gametes. Heterogamy.

**Digen-esis, -y.** Alternation of generations (*q.v.*). Sexual and asexual reproduction.

**Digenoporous.** *Syn.* Digonoporous. Having two (m. and f.) genital apertures.

**Digestion.** Process of rendering food absorbable. Essentially it is a series of *fermentations*: (1) *amylolytic*, in which glycogen and starch are converted into sugar; (2) *proteolytic*, where proteids are changed to peptones and proteoses; (3) *saccharine*, in which sugars are broken up by zymases; (4) *lipasic*, where diastases split up oils and fats into fatty acids and glycerol.

**Digitigrade.** Walking on tips of fingers and toes. *Cf.* Plantigrade.

**Digoneutic.** Breeding twice yearly. **Digonoporous.** Digonoporous (*q.v.*).

**Dihybridism.** Crossing between two organisms which differ as regards two pairs of alternative characters.

**Dimersal.** *Syn.* demersal (*q.v.*).

**Dimorphism.** Having two dissimilar forms. Having two types of stamens, flowers, leaves, zooids, offspring, or sex-organs.

**Dinergate.** A macro-cephalic soldier ant. **Dinoceras.** *Tinoceras*.

**Dinosaurs.** O. of terrestrial, bird-like, mesozoic reptiles which varied in length from 2 ft. (*compsognathus*) to 90 ft. and over (*atlantosaurus*). **Dinotherium.** A Miocene elephant.

**Diode.** Two-electrode valve for rectifying alternating currents.

**Dioecious.** Single sexed. Having m. organs on one pl. or an. and the f. organs on another. *Opp.* hermaphroditic.

**Dioptric.** Refractive. *Cf.* Catoptric.

**Dip.** (1) Angle formed  $\bar{c}$  horizon by freely-suspended mag. needle; =  $0^\circ$  at mag. equator,  $90^\circ$  at mag. poles. (2) Inclination of strata to horizontal.

**Diphycercal.** *App.* a fish-tail that is symmetrical—i.e., in which the backbone runs straight to the end. *Cf.* Protocercal. **Diphygenic.** With two modes of development. **Dyphyletic.** Having two ancestral lines. **Diphyodont.** Having two sets of teeth—e.g., milk and permanent.

**Diplanetic.** Having two types of zoospores.

**Dipleura.** A bilaterally-symmetrical an. **Dipleurula.** Bilaterally-symmetrical larva of echinoderms. *Syn.* echinopædium, -pluteus.

**Diplodocus.** Jurassic marsh-frequenting dinosaur about 90 ft. long.

**Diploë.** (1) Cancellous bony tissue between plates of skull-bones. (2) Mesophyll.

**Diplogen.** Heavy hydrogen atom.

**Diploid.** The normal No. of chromosomes in an immature gamete, a body-cell, or a zygote. It is expressed as  $2n$ ,  $n$  being the haploid No. in a mature gamete. In a diploid the basic (haploid) chromosome no. is doubled, in a triploid it is trebled, and so on. *See* Polyploid; Trisomic. **D. cell.** A cell with two members of each chromosome pair; thus a gametophyte is in the haploid

phase with  $n$  chromosomes; a sporophyte is in the diploid phase with  $2n$  chromosomes.

**Diplonema.** Double chromatin thread in diplotene stage.

**Diplont.** An organism with diploid body-cells. **Diplophase.**

Diplophase or diploid stage. **Diplopia.**

Double vision of a single object. **Diplosis.** Doubling the No. of chromosomes

by uniting two haploid sets. **Haplosis** consists in reducing

the chromosome no. by div. into 2 haploid sets. **Diploptegia.**

An inferior ovary with dry indehiscent pericarp. **Diplo-**

**tene.** Stage following the pachytene in which bivalent

chromosomes split lengthwise.

**Dipneust.** **Dipnoi.** *Sub.-cl.* of fishes that breathe by gills

and by lungs. *Syn.* mud-fish; lung-fish. *Ex.* *Neoceratodus*

with single air-bladder-lung. (Queensland.) *Protopterus*, double

air-bladder-lung. (Nile.) *Lepidosiren*. Double air-bladder-lung. (Amazon.) **Diptera.**

O. of insects including flies.

**Directrix.** A straight line so situated with respect to a

conic section that the distance of any point of the curve from

it has a constant ratio to the distance of the same point

from the focus.

**Discharge, elec.** Act of equalizing a surplus or deficit

of electrons in two charged conductors. The flow of elec-

trons from a conductor at high, to one at low, potential.

**Discus proligerus.** Mass of cells immediately surrounding

mammalian ovum and fixing it to wall of Graafian follicle (*q.v.*).

**Disease.** The serial reactions of an organism to life-endanger-

ing stimuli.

**Disintegration, geo.** Crumbling of rocks. *Phy.* Disruption

of nucleus of atom. *Ch.* Molecular separation. *Opp.* poly-

merization.

**Dissepiment.** Partition in compound ovary or between

septæ of coral.

**Dissilient.** Dehiscing violently. *Ex.* balsam.

**Dissociation.** (1) *Psy.* The separation of one el. of con-

sciousness from the "main stream" of consciousness. (2)

*Ch. Phy.* Partial decomposition. Ionization.

*Ex.*  $H_2SO_4$  at  $325^\circ C.$  becomes 50

p.c.  $H_2SO_4$  and 50 p.c.  $H_2O + SO_3$ .

The breaking up into simpler constituents of a compound (*e.g.*, by heat),

which constituents can recombine to form original compound on cooling.

The breaking up of electrolytes into ions. *Cf.* Decomposition.

**Disso-geny, -gony.** Condi-

tion of having two sexually mature periods in one organ-

ism, the one during the larval, the other during the adult,

state.

**Distal.** Extremity of a part furthest from a centre, axis,

mid-line, or mid-plane. *Opp.* proximal.

**Distance receptors.** Recep-

tors which react to a contacting agent emitted by a distant

object—*e.g.*, retina, internal ear.

**Distillation.** Conversion of a liquid into a vapour with re-

condensation of the latter and its collection in another vessel.

**Ditokous.** Producing two eggs or two young only at

birth.

**Diverticulum.** A blind tube that branches off from a

chamber or canal.

**Division; Cell.** The splitting of a single cell into two

daughter-cells. **Division of labour.** Distribution of specialized activities to special groups of cells, organs, or individuals.

A primitive, single, cell is physiologically complete in itself; it can contract and expand, rest and move, feed, digest, secrete, and excrete, it can receive stimuli, conduct impulses, and react to its environment, it can breathe—i.e., absorb O and expel CO<sub>2</sub>. In a higher an.—i.e., a massed group of cells—each of these performances is undertaken by different groups of specialized cells, muscle-cells which contract, nerve-cells which conduct, stomach-cells which digest, and so on. This carrying out of definite functions of specialized cell-groups is called *Division of Labour*, differentiation (q.v.) or ergonomy.

**Dodder.** A thread-like, leafless, pl. parasite, parasitic on other pls.

**Dodecahedron.** A solid with 12 plane surfaces.

**Dolabriform.** Hatchet-shaped.

**Dolichocephaly.** Long-headedness. Having breadth of head 75 p.c., or less, of length of head. *Syn.* scaphocephaly. *Cf.* Brachycephalic. *See* Cephalic index.

**Dolioform.** Barrel-shaped.

**Dominant.** A gene which (as one of a pair of allelomorphs) obscures the action of its (recessive) allelomorph when present with it in the heterozygous state.

**Doppler's principle.** *Apparent* change in value of a wave-no. consequent on a change of distance between an observer and the wave source. *See* "Red Shift," S.L.

*E.g.*, a sound becomes shriller than the real note emitted as its source approaches, and deeper than the real note as its source recedes from, an observer. Spectral lines are shifted towards the violet if the distance between an observer and a star is de-

creasing, towards the red if the distance is increasing.

**Dorsal.** *Per.* back. *Opp.* ventral. **Dorsigrade.** Walking on backs of digits (sloth).

**Dorylaner.** A very large m. driver-ant.

**Drepanium.** A helicoid cyme with axes in planes parallel to that of main peduncle.

**Dromotropism.** Spiral curving of pl.

**Drone.** A functional m. bee.

**Drupe.** A superior, one-celled fruit with fibrous epicarp and fleshy sarcocarp (mesocarp) and a hard endocarp ("stone"). *Ex.* cherry. **Druper, Drupelet.** An individual component of a *collective* fruit such as raspberry or blackberry.

**Dualism.** Theory which assumes two ultimate realities, *mind* and *matter*. *Cf.* Monism.

**Ductility.** Capacity of being drawn out into fine threads, or hammered into thin laminae. *Ex.* gold, an ounce of which can be drawn out to 87,000 yards forming a thread thinner than that of the spider, or hammered out to 100 sq. ft. 1/282,000 in. thick, a thinness that allows passage through it of blue light.

**Ductless glands.** Glands of internal secretion. Endocrine glands. These glands do not communicate *directly* with the organs they specially affect (by stimulating or inhibiting), but pour their secretions into the blood stream, and these are carried by the latter to the appropriate organ. *Ex.* pancreas; pituitary; thyroid.

**Dulosis.** Slavery among ants.

**Duodenum.** First loop of small intestine between stomach above and ileum below.

**Duramen.** Hard, tough "heart-wood" of dicotyledonous stem. *Cf.* Alburnum.

**Dwarf star.** A small, but very high mass, high-density, feebly-luminous star.

The type is much more common than the giant-stars (of *opp.* nature). Dwarf-stars, as a rule, represent a late stage of evolution. *Ex.* van Maanen's star in which 400,000 grammes of matter occupy 1 cm.<sup>3</sup>, as compared with 3/5,000,000 gramme per cm.<sup>3</sup> in the case of the *giant* star alpha Orionis.

**Dyad, bio.** A pair. The pair of cells formed by div. of a tetrad after meiosis. A univalent chromosome composed of 2 chromatids. *Ch.* A bivalent el., atom, or radicle.

**Dynamics.** Study of *force in action*—i.e., of the motion of bodies. *Cf.* Statics.

**Dynamo.** A machine for converting mechanical into elec. energy by magneto-electric conduction. It consists in essence of a system of conduc-

tors rotating within a system of magnets. *Syn.* generator.

**Dyne.** C.g.s. unit of force. The force which, applied to one-gramme-mass gives it an acceleration of (increase of vel. of) 1 cm. per sec. in each sec. The *practical* unit of force is a gramme *weight*, and this, at sea-level and lat. 45°, exerts a gravitational force of 980·616 dynes—i.e., 1-gramme-weight = 980·616 dynes.

**Dysgenesis.** Infertility, especially between hybrids which are fertile with members of either parent line. **Dysgenic.** Tendency towards racial degeneration. Counteracting racial improvement by influencing the genes. *Syn.* kakogenic. *Opp.* eugenic. **Dysphotia.** Dwelling in feebly-illuminated zones. **Dyspnoea.** Breathlessness with laboured respiration. **Dysprosium, ch. el.** Dy. Most magnetic metal known. *At. no.* 66; *at. wt.* 162·460. **Dys-teleology.** Doctrine of *absence of purpose* in Nature. *Opp.* teleology. **Dystrophy.** Faulty nutrition.

## E

**Ear.** Organ consisting of a sound-wave amplifier and detector and a balancing organ. It consists of the *external e.* (pinna and meatus); the *middle e.* (tympanum) (*q.v.*); the *internal e.* (labyrinth) (*q.v.*).

**Ebullition.** Boiling. The giving off by a liquid of bubbles of vapour from its depths.

**Ecbatic.** *Per.* a natural, as compared with a telic or purposive, result. **Ecdemic.** Not native. **Ecderon.** *Syn.* epi-

blast (*q.v.*). **Ecdysis.** Moulting (*q.v.*). *Cf.* Endysis. **Echinate.** Having spines or bristles. **Echinoderms.** Radially-symmetrical marine inverts. There are 10,000 species (*q.v.*). *Ex.* starfish. **Echinoidea.** Sea-urchins. **Echino-podium, -pluteus.** *See* Dipleurula.

**Ecliptic.** Apparent path of sun on celestial sphere. *E.*, obliquity of. The angle (23° 26' 49·5") between plane of *e.* and plane of celestial equator at equinoctial points.

**Ecology.** Natural history. Bionomics (*q.v.*). Hecicology. Study of relationship between organism and environment.

**Ectoblast.** Outer layer of ectoderm. *Syn.* epiblast.

**Ectocarp.** A pl. with ectodermal germ-cells. **Ectocoel.** Cavity outside enteron. **Ectocyst.** Outer covering of cyst or of zoecial wall. *Syn.* epicyst.

**Ectoderm.** Outer single-celled germinal layer of primitive enteron. *Syn.* ecderon; ectoblast; epiblast; epidermis; exoderm. **Ectogenous.** Able to live independently.

**Ectomere.** A skin-forming unit. **Ectoparasite.** A parasite that dwells upon exterior of an organism. *Cf.* Endoparasite; Epiphyte. *Syn.* ecto-phyte, -zoon; epiparasite.

**Ectophyte.** An epiparasite. **Ectoplasm.** Outer part of cytoplasm. *Syn.* ectosarc; ecto-, peri-plast; exoplasm. *Cf.* Endoplasm. **Ectoplast, -sarc.** *Syn.* ectoplasm (*q.v.*).

**Ectothea.** Outer coat—*e.g.*, of gonangium. **Ectotrophic.** Feeding outside. *App.* mycelium of fungi which surrounds roots. *Cf.* Endotrophic.

**Ectozoon.** *Syn.* Ectoparasite (*q.v.*). **Edentata.** The O. of mammals that includes armadillos, sloths, and ant-eaters.

**Effector.** A cell or cell-group with executive functions. It is linked up proximally by a connector (*q.v.*) to a receptor (*q.v.*) and distally to some organ (muscle, gland, etc.) where work is to be effected. **Efferent.** Conveying outwards—*i.e.*, away from a centre. *Cf.* Afferent.

**Efficiency.** Doing work with economy. Ratio of output and

intake of energy—*i.e.*, energy transformed divided by total energy absorbed.

**Efflorescence.** (1) A blossom. (2) A period of flowering. (3) A powdery incrustation on crystals due to loss of water.

**Egest-a, -ion.** Sum-total of materials thrown out of an organism. The act of voiding them.

**Egg.** An ovum *plus* its nutritive material. The size of eggs varies from microscopic dimensions (*e.g.*, 1/125 in. in man) to 484 cub. in. = 2 galls. = 20 lbs. (*ex. æpyornis*). If nourished within the mother it is small (mammals); if nourished outside large (birds). *Syn.* oosphere. *See* Embryosac. **E.-tooth.** A hard knob on upper surface of beak and snout respectively of embryo birds and reptiles for breaking open the shell.

**Ego.** The self-conscious personality. The conscious subject of experience. An evanescent collocation of matter-energy.

"A mere asymptotic regress towards a notional pure subject of knowledge—a thinker without thoughts, an abstraction, nothing at all." (Lord Haldane.)

**Elaiodochon.** The "oil-gland" (*q.v.*). **Elaio-plast, -some.** Intracellular oil-forming plastids, etc.

**Elasmobranchs.** *Sub.-cl.* of fishes, including sharks.

**Elasticity.** Property enabling a body to recover its original shape when the external deforming force is withdrawn. **E., coefficient of.** The ratios of a caused strain to the causal stress.



**Electric charge.** The surplus (if negative c.) or deficit (if positive c.) of electrons in the surface atoms of a conductor. **E.c., unit of.** The c. which exerts a force of 1 dyne upon an = charge 1 cm. away. **E. current.** Flow of electrons through a conductor. The passage of 3.79 trillion electrons across a section of wire *per sec.* = one ampere. See Solution; Pressure. **E. potential.** Degree of electrification —e.g., a neutral atom has higher e.p. than an atom deficient in electrons (i.e., positively charged), but a lower e.p. than an atom with a surplus of electrons (i.e., negatively charged). **Electricity.** Fundamentally, electrons and protons (*q.v.*). Negative e. = the electron; positive e. = the proton. The unit of quantity of e. is the amount of e. represented by a proton or by an electron which is  $4.774 \times 10^{-10}$  electrostatic units. The *practical* unit is the coulomb (*q.v.*). **Electrode.** The positive or negative pole (or plate) of primary, secondary, or electrolytic cell. Conductor in a thermionic valve. **Electrolysis.** Dissociation of atoms in a solution by an electric current and their conversion into *ions* which, reaching an electrode, re-form as atoms which are deposited as solids or liberated as gases. **Electrolyte.** (1) A solution of which the solute mols. partially dissociate into ions during passage of electric current. (2) Any solute (*q.v.*) which dissociates into ions and so renders the liquid electrically conductive. **Electromagnet.** A soft iron rod within a coil of

wire conveying an electric current. **Electromagnetic.** (1) *Per.* magnetism developed by electric current. (2) *Per.* interrelation of magnetism and elec. **E.M. Unit (E.M.U.).** **E.M.U. capacity.** That capacity which is charged to unit potential by unit quantity.  $10^{-9}$  E.M.U. cap. = 1 farad. **E.M.U. current.** That constant current which, passing through a circular wire 1 cm. radius produces a magnetic field with an intensity of  $2\pi$  gauss at centre of circle.  $10^{-1}$  E.M.U. current = 1 ampere. **E.M.U. E.M.F.** The E.M.F. generated in a closed circuit by a variation of one maxwell per sec. in the magnetic flux through the loop. **E.M.U. energy.** The energy expended in a circuit in which an unvarying unit E.M.F. produces constant unit current for one sec.  $10^7$  E.M.U. energy = 1 joule. **E.M.U. magnetic pole.** The magnetic pole which repels a like = pole, *in vacuo*, 1 cm. distant with a force of 1 dyne. **E.M.U. potential.**  $10^8$  E.M.U. potential = 1 volt. **E.M.U. power.** The power which is = an expenditure of unit energy *per sec.*  $10^7$  E.M.U. power = 1 watt. **E.M.U. quantity.** The quantity conveyed by unit current *per sec.*  $10^{-1}$  E.M.U. quantity = 1 coulomb. **E.M.U. resistance.** The resistance through which unit E.M.F. causes a flow of unit current.  $10^9$  E.M.U. resistance = 1 ohm. **Electromagnetic wave.** *Syn.* ether-wave. A "disturbance" propagated through space (? ether) with a vel. of 186,300 miles *per sec.* including gamma, "x", ultra-violet, light,

infra-red-, hertzian-, and "wireless"-waves. **Electromotive force.** (E.M.F.) Electric pressure. Voltage. Potential difference. The force that causes electrons to move through a circuit.

**Electron.** A fundamental of the atom. Negative elec. *Syn.* negatron. *Sym.*  $e^-$ . See Atom, Atomic Number. See also S.L.

When fixed by a proton (*q.v.*) inside the nucleus of an atom it is termed a *cementing e.*; revolving in an orbit around the nucleus of the atom it is known as a *planetary e.* The *at. no.* of an atom = the no. of planetary electrons. The *e.* is larger in vol. than the proton, but has only 1/1845 its mass. The mass of the *e.* is  $9.1066 \times 10^{-28}$  gramme; its radius is  $1.87 \times 10^{-13}$  cm. It represents a quantity of elec. =  $1.6 \times 10^{-19}$  coulombs; its charge is  $4.8025 \times 10^{-10}$  E.S.U. or  $1.602 \times 10^{-20}$  E.M.U. Its frequency is  $124 \times 10^{18}$  oscillations per sec. Electrons repel one another but attract, and are attracted by, protons. Beta-"rays" are high-vel. electrons; delta- and cathode-"rays" are low-vel. electrons. In space the *e.* behaves as a *particle*; after colliding with "matter" it behaves as a *wave*. See also Radium; Uranium; Atomic Number; Atomic Weight.

**Electro-negative.** Negatively charged. *App.* atoms with neg. valence that pass to *anode* (*q.v.*). **Electro-positive.** Positively charged. *App.* atoms with positive valence that pass to *cathode* (*q.v.*). **Electrosome.** An organizing chondriosome. **Electrostatic.** *App.* "fixed" electricity. **E.S. field.** Space occupied by lines-of-force radiating centrifugally from a positively-charged body and centripetally towards a negatively-charged body; together with the magnetic field at right angles to the lines-of-force. **Electro-static Unit (E.S.U.)** (1) of capacity. A capacity charged to unit potential by unit quan-

tity in a medium whose dielectric constant is = unity. A sphere with 1 cm. radius has unit capacity.  $9 \times 10^{11}$  E.S.U. capacity = 1 *farad*. (2) **E.S.U. of current.** A current conveying unit quantity per sec.  $3 \times 10^9$  E.S.U. = 1 *ampere* (*q.v.*).

The E.S.U. or unit of electrical quantity is the elec. charge which exerts upon a second charge of same size at a distance of 1 cm. a force equal to a pull by a weight of 1.02 milligrams.

(3) **E.S.U. of energy.**  $10^7$  E.S.U. = 1 *joule*. (4) **E.S.U. of difference of potential** is the difference requiring an expenditure of an erg of work in moving a unit quantity from one point to another.  $1/300$  E.S.U. potential = 1 *volt*. (5) **E.S.U. of power.**  $10^7$  E.S.U. power = 1 *watt*. (6) **E.S.U. of quantity (charge)** is the quantity which, in a medium of unit dielectric constant repels a like = quantity 1 cm. away with a force of 1 dyne. It is  $10^{10}/4.77$  electrons.  $3 \times 10^9$  E.S.U. quantity = 1 *coulomb*. (7) **E.S.U. of resistance** is the resistance between the ends of which unit difference of potential exists.  $10^{-11} \div 9$  E.S.U. resistance = 1 *ohm*. **Electrotaxis.** Response of an organism to an electric current or field. *Syn.* electrotropism. **Electrotonus.** Condition of tension in a nerve through which a constant current is passing. See An-, Kat-electrotonus. **Electrotropism.** *Syn.* electrotaxis.

**Element.** A substance containing only one kind of matter. A substance, all the atoms of which have the same *at. no.*

An ultimate constituent of (ordinary) matter. There are some 92 known els.

**Elytra.** An ant. pair of "wings" which ensheath a post. pair of flying wings. Dorsal scales or plates.

**Embolus.** A blood-clot inside a blood-vessel.

**Embryo, bot.** Earliest mass of cells into which zygote develops. It is nourished by the endosperm and lies within the embryo-sac (*q.v.*). **Zoo.** Mass of cells after div. of zygote and, in mammals, up to the stage of the *fœtus* (*q.v.*). In man the first six weeks of intrauterine life. **E. lobe.** A cotyledon. **E. sac.** A chamber within the ovule in which pl. begins its development. *Syn.* seed. **Megaspore. Embryogenic pole.** The cell-group in the yolk from which arise the *hypoblast*, *epiblast*, and *mesoblast*. *Syn.* an. pole. *Opp.* vegetative pole. **Embryogeny.** Embryo formation. **Embryology.** Study of embryos. **Embryonic plate.** The three-layered (*ecto-, meso-, endo-derm*) stage of embryo.

**Emergence, bio.** Appearance of new substances, structures, parts, organs, qualities, and relationships, through rearrangement of pre-existing entities. *Ez.* water "emerges" when two gases, H and O, unite.

**Emulsion.** *Suspension* in one fluid of another immiscible one.

**Enamel, bio.** Dense covering of dentine of tooth.

**Encephalon.** Brain.

**Enchylema.** Liquid part of cell.

**End-buds, -bulbs.** A ramified expansion of a nerve which receives (skin), or discharges

(muscle), stimuli. *Syn.* end-organs; end-plates.

**Endoblast.\*** Inner embryonic layer. *Syn.* endoderm; hypoblast. **Endocarp.** Inner layer of "fruit" or pericarp. **Endocrine glands.** Ductless glands (*q.v.*). **Endocrines.** Ch. compounds formed by organs of internal secretion which stimulate (hormones—*q.v.*), or inhibit (chalones), various organs of the body. *Syn.* ch. messengers. *Ez.* insulin. **Endocyst.** Inner layer of cyst or zooid. *Cf.* Epicyst. **Endoderm.** Inner cell-layer, especially of the enteron. *Syn.* hypoblast. **Endodermis.** Inner layer of pl. cortex. **Endogamy.** Fusion of m. and f. gametes—i.e., zygote formation within parental cell-envelope. Inbreeding. *Cf.* Exogamy. **Endogonium.** A gonidium formed within a receptacle. **Endolymph.** Fluid of membranous labyrinth of ear. **Endoparasite.** An organism living within, and at expense of, another organism. *Syn.* entozoon. *Cf.* Ectoparasite; Symbiosis. **Endophyte.** A pl. growing within tissues of another pl. **Endoplasm.** The interior, granular, more liquid part of cytoplasm. *Syn.* endosarc. *Cf.* Ectoplasm. **Endopleure.** Inner seed coat. **Endorgan.** *Syn.* end-bud (*q.v.*). **Endosarc.** *Syn.* endoplasm (*q.v.*). **Endoskeleton.** The bone-cartilage support of vert. *Cf.* Exoskeleton. **Endosmosis.** Passage *inwards* of a gas or liquid through a membrane. *Cf.* Exosmosis. **Endosome.** *Syn.* karyosome (*q.v.*). **Endosperm.** Tissue within

\* Endo; also as Ento (*q.v.*).

seed that nourishes the embryo. **Endospore.** An asexual spore. Inner coat of sporocyst. **Endostyle.** The ciliated mucus-conveying hypopharyngeal groove of Ascidians—a precursor of the higher vert. thyroid gland. **Endothelium.** Cell-lining of internal cavities—heart, blood-vessels, etc. **Endothermic.** *See* Heat. **Endotrophic.** Obtaining nourishment from the inside of a host. *App.* root-penetrating fungi. *Cf.* Ectotrophic. **Endplate.** *Syn.* end-bud (*q.v.*).

**Endysis.** Development of new skin-structures. *Cf.* Ecdysis.

**Energy.** Capacity to do work and overcome resistance. *See* Mass.

*App.* any motive power to work, or what can be obtained from or changed into work. In space *e.* = radiation; on impact with matter *e.* does work in moving atoms (= heat, chemism), or in moving electrons (= hertzian waves). The unit of *e.* is the work done in lifting 1 lb. through 1 ft. = 1 ft. lb. or, in c.g.s. terms, is the force which, acting on a gramme, gives it each sec. an acceleration of 1 cm. per sec. The energy of a body in virtue of motion is called *kinetic e.* (*ex.* bullet in flight), the *e.* of a body in virtue of position (pendulum at top of swing) or to displacement of particles (wound watch-spring) is called *potential e.* The total energy possessed by the mols. of a body represents its *heat.* The *practical* unit of work is the joule (*q.v.*) =  $10^7$  ergs.

**Entelechy.** A supposed vital, telic, or purposive principle guiding and controlling organisms and their evolution.

**Enterceptive.** *App.* afferent impulses. *Cf.* Exteroceptor.

**Enteron.** The alimentary canal.

**Entomology.\*** Study of in-

sects. **Entomophilous.** Pollinated by insects. **Entozoa.** Endoparasites (*q.v.*).

**Entropy.** Quantity of heat in a body divided by its *absolute* temp. Unconsumed energy unavailable for mechanical work.

*E.* expresses the idea that all movement (in a limited system) tends to be transformed into a uniformly-distributed heat. It is a numerical expression which increases as energy loses availability. *See* Thermodynamics.

**Environment.** Everything, animate or inanimate, that acts upon, or is capable of acting upon, an organism. Hence it includes the non-living material of the organism itself. The receptive range of an organism.

**Enzyme.** An organic catalyst or ferment that can cause change in another substance without itself suffering appreciable change. *Ex.* pepsin. There are three main types of enzymes: lipo-, proteo-, and suco-clastic.

**Eocene.** Oldest div. of tertiary; it precedes the oligocene and follows the cretaceous.

**Eogæa.** Africa, S. America, Australia, and New Zealand. *Cf.* Cænogæa.

**Epibasal, bot.** Anterior to basal wall. *Cf.* Hypobasal. *See* Archesporium.

**Epiblast.** Outermost layer of cells in gastrula and embryo. *Syn.* ecderon; ectoderm, -blast. **Epicarp.** Outer layer of pericarp. **Epicritic.** *App.* very delicate skin sensations. **Epicyst.** Ectocyst. **Epidermis.** Outer part of pl. stem, external to cortex. Cuticle or outer skin-layer of

\* Ento. *See also* under Endo.

an. *Syn.* ectoderm. **Epiglot-**tis. A gristly flap at entrance to windpipe. **Epigynous.** Ad-nate to pl. ovary. *See* Corolla.

**Epiparasite.** Ectoparasite (*q.v.*). **Epiphragm.** A horny (mucoid) layer closing shell of gasteropods (*ex.* snail) during hibernation. Membrane clos-ing cavities in mosses and fungi.

**Epiphysis.** (1) A cartilaginous process which ossifies separ-ately and later joins up with a main bone. (2) Pineal body.

*Cf.* Diaphysis. **Epiphyte.** A pl. which grows, but does not feed, upon another pl. Also a pl. parasitic on an an. *Cf.*

**Epizoon, Ectoparasite. Epi-plankton.** Plankton down to 600 ft. depth. **Episematic.**

*Per.* recognition markings and colouring. **Epistasis.** Pre-

domination of two characters whose genes are non-allelo-morphic. *Cf.* Hypostasis.

**Epithelium.** Cell layer cover-ing an external or internal free surface. **Epizoon.** An organ-ism that lives, not necessarily parasitically, on the surface of animals. *See* Epiphyte.

**Epoch, geo.** Time-length in-cluding *ages*; included in *period*.

**Equinoctial.** The celestial equator. **E. points.** The two points (*c.* March 21, Sept. 23) where sun, in its yearly ap-arent revolution around ecliptic, crosses the celestial equator. **Equinox.** Time

when sun crosses equator and day and night lengths are equal and when axis of earth is perpendicular to line joining centres of sun and earth. The vernal *e.* is about March 21, the autumnal *e.* about Sept. 23.

**Erbium, ch. el.** Er. Metal. *At. no.* 68; *at. wt.* 167.64.

**Eremophyte.** A desert pl. **Ereutophobia.** Fear of blushing.

**Erg.** Unit of work and energy.

It is twice the kinetic energy of a gramme at a vel. of 1 cm./sec. or is = work done by a force of 1 dyne acting over a distance of 1 cm. A ft. lb. =  $1.85 \times 10^7$  ergs.; a joule =  $10^7$  ergs; a calorie =  $4.19 \times 10^7$  ergs.

**Ergastoplasm.** Archiplasm (*q.v.*). **Ergatandromorph.** A

"worker" with m. characters. **Ergataner.** A "worker"-like m.

**Ergate.** A "worker" (neutral) ant. **Ergatogyne.** A

"worker"-like f. **Ergato-morph.** A neutral ant changed to a m. or f.

**Ergosterol.** Pro-vitamin D. **Ergot.** (1) Relic of "sole"

or "palm" on limb of horse. (2) Fungus of rye.

**Erythrin.** Red colouring-matter of pl. **Erythroblast.**

Nucleated red blood cell; pre-cursor of **Erythrocyte** or red blood corpuscle. *Syn.* hæmato-blast (*q.v.*). **Erythrophyll.**

Red colouring-matter of leaves.

**Ether.** (1) Hypothetical space-pervading medium giving passage to radiations. (2) An inflammable liquid used as an

anæsthetic.  $(C_2H_5)_2O$ . Ethyl oxide.

**Etiolation.** Pale yellow col-oration of pl. grown in absence of light, due to deposit in the chloroplasts of **Etiolin.** Yellow

pl. pigment; a precursor of chlorophyll.

**Eucephalous.** Having a head. *Opp.* acephalous.

**Eugenic.** *Opp.* dysgenic (*q.v.*). **Eugenics.** Science deal-ing with *physical* racial im-

provement. *Cf.* Euthenics.

**Euporium**, *ch. el.* Eu. Metal. *At. no.* 63; *at. wt.* 152.00.

**Eustachian tube**. Passage from throat to middle ear serving to equalize pressure on drum.

**Euthenics**. Science dealing with mental racial improvement. *Cf.* Eugenics.

**Eutheria**. *See* Classification.

**Evaporation**. Imperceptible change of liquid to vapour by escape of mols. at surface. *Cf.* Ebullition. **E.**, latent heat of. *See* Vaporization.

**Evolution**. Metamorphosis. Transmutation. Development.

The origin of a race or species from another race or species. The origin of relatively more complex forms of sub-atoms, atoms, mols., and compounds from relatively more simple forms respectively; also the reverse. The production of something new through the synthesis and reshuffling of pre-existent entities. *e.* is both "upward" and "progressive"—towards greater differentiation—and "downward" and "retrogressive"—towards greater simplicity. The principal factors of cosmic *e.* are heat and motion, of organic *e.* variation and heredity.

**Excretion**. Elimination of waste products by a specific organ, such as contractile vacuole of amoeba or kidney of mammal. **Exocarp**. Outer layer of pericarp. **Exocrine gland**. A gland with ducts. *Cf.* Endocrine. **Exogamete**. A gamete that conjugates with another of a different brood. **Exogamy**. Outbreeding. *Cf.* Endogamy. **Exogenous**. Growing from (and by addition to) superficial tissues. **Exoplasm**. *Syn.* ectoplasm (*q.v.*). **Exoskeleton**. The external horny supporting structure and defensive armature of inverte-

brates. *Syn.* dermoskeleton (*q.v.*). *Cf.* Endoskeleton. **Exosmosis**. Outward passage of liquid or gas through a membrane. *Cf.* Endosmosis. **Exotactism**. *Syn.* Diageotropy (*q.v.*). **Exothermic**. *See* Heat. **Exotospore**. A sporozoite. **Exo-tropism, -tropy**. Diageotropy (*q.v.*).

**Expansion**; coefficient of. (*Linear*) Increase of unit length of a body in passing from 0° C. to 1° C. (*Surface*) Increase of unit surface of a body in passing from 0° C. to 1° C. It = twice the linear. (*Cubical*) Increase of unit vol. of a body in passing from 0° C. to 1° C. It = thrice the linear.

**Expiration**. Act of emitting gases, vapours, and waste-products from a respiratory organ. **Extensor**. Muscle which straightens out a limb, or stretches a part. *Opp.* flexor. **Exteroceptor**. A receptor which deals with stimuli from outside the body (contact, cold, warmth, light, sound, and noxa). *Cf.* Inter-, Proprioceptor. **Extrorse**. *App.* anther in which pollen openings face away from pistil. *Cf.* Introrse.

**Eye**. An organ of "vision" from a mere pigment-spot in lower an. to the complex structure of higher inverts. and verts. *See* Ocellus; Ommatidium. **E.**, parietal. A vestigial third eye in cyclostomes which was probably functional in older (*e.g.*, ostracoderms) fishes. **E.**, pineal. *Syn.* parietal *e.* *See also* Pineal body. **Eyelid, third**. Nictitating membrane (*q.v.*).

## F

**Fabiform.** Bean-shaped.

**Facial angle.** Angle included between a straight line passing from foremost and most prominent point of forehead to foremost and most prominent point of upper jaw, and another straight line passing from this latter point to a straight line joining apertures of ears.

The more acute this angle the lower, in general, the type. Below 80° the head is *prognathous*; from 80-85° *mesognathous*; above 85° *orthognathous*. Ex. dog, 25°; gorilla, 31°; orang, 47°; chimpanzee, 55°; Tasmanian Negro, 70-80°; Chinese, 80-85°; Arab, European, 85-90°.

**Faculae.** Streaks or projections upon sun's photosphere that are brighter than general surface. Prominences. (?) (*q.v.*). Cf. Sunspots.

**Facultative, bio.** Capable of living under diverse conditions. *App.* organisms that are free-living and self-dependent at one time (saprophytes) and need a "host" upon which to feed at another (parasites). See Fungus.

**Fading, elec.** Absorption of short waves by ionosphere (*q.v.*) and their consequent failure to be reflected back to earth to activate receiving sets. Cause: wave interference; sunspots; ionosphere movements. See Interference.

**Fæces.** Voided contents of alimentary canal. Excrement. Droppings.

**Falc-ate, -iform.** Sickleshaped. **Falcula.** A curved claw.

**Fallopian tube.** Upper part of mammalian oviduct.

**Family.** Group of an O. See Classification.

**Farad, elec.** Unit of capacity. Capacity of condenser which, charged with 1 coulomb, gives a potential difference of 1 volt. 1 f. =  $10^{-9}$  (c.g.s.) E.M.U. of capacity or is =  $10^{11}$  (c.g.s.) E.S.U. of capacity. See Capacity.

**Farad-ism, -ization.** Stimulation by induced (interrupted) electric current.

**Fascia.** Condensed connective-tissue which ensheaths, binds, or supports a part. **Fasci-ated, -cular.** Arranged in bundles.

**Fastigate.** Having upwardly-directed branches that are nearly parallel to main axis. United as a conical or pyramidal bundle.

**Fat.** Adipose tissue.

A tissue mainly composed of oil-distended cells—i.e., cells specialized for elaborating "fat" or oil. Olein is 100 p.c. oil or fat; butter 84.5 p.c.; herring, 13.8 p.c.; egg, 11.3 p.c.; milk, 3.8 p.c.; potato, 1.0 p.c. Chemically, fats and oils are esters (quasi-salts) of glycerol ( $G = C_3H_5O_3$ ).

**F.-body.** A richly-vascularized mass of lymph-cells and oil-globules present in cert. hibernating an. (amphibia, reptiles) which are at their largest in the spring just before egg-laying begins. They are regarded as reserve food-stores for the exclusive use of the ovaries and testes, which become active before hibernation finishes and therefore before the an. is able to feed. As a "packing" around abdominal organs of

insects fat probably serves a similar purpose.

**Fatigue of metals.** The particles of metals, glass, etc., when acted on by continuous forces tend to undergo change of relative positions which renders them more liable to rupture with advance of time. Conversely, the application of gradually increasing forces, with intervening rest-periods, causes such particles to readjust themselves in such manner that they can resist forces which, normally, would disrupt them. This weakening and strengthening has been termed "fatigue" and "accommodation" respectively. A blunt razor blade after prolonged "rest" recovers much of its former sharpness. Steel which will stand heavy load stresses (tension and compression) is apt to rupture if subjected to stresses alternating rapidly between half the tension load and half the compression load. There is also a "fatigue" and "recovery" of electrodes with over- and under-use. Cf. Hysteresis.

**Fauces.** Passage from mouth to pharynx. Mouth of a spiral shell. "Throat" of corolla.

**Fault, geo.** Fracture of earth's crust with displacement of one side of the fracture. Dislocation of strata.

**Fauna.** Animals, but especially those peculiar to a district or period. Cf. Flora.

**Faveolate.** Honey-combed. Alveolated. Many-chambered. *Syn.* favose. **Faveolus.** Any depression. *Syn.* alveolus. **Favose.** *Syn.* faveolate (*q.v.*).

**Feather.** A light, horny, epidermal outgrowth forming

part of plumage of birds and which, in origin, is a modified reptilian scale. It consists of a shaft (*quill*), the *rachis* bearing the *barbs*, which bear the *barbules* terminating in the *barbicels* and *hamuli*. All *q.v.* See also Remiges, Rectrices, Pterylæ. F. stars. Crinoids.

**Fechner's law.** For middle ranges the intensity of sensation increases as the log of the stimulus. Sensation increases in arithmetical, strength of stimulus in geometrical, progression.

**Fecundation.** Fertilization (*q.v.*). Impregnation. Pollination.

**Feeler.** Any tactile organ; antenna, palp, tentacle.

**Female.** An organism (or organ) producing ova or eggs which, fertilized by a male (*q.v.*), develop into new individuals. *Ex.* mare; pistil. **F. pronucleus.** Nucleus of ovum after expulsion of polar bodies. *Syn.* germinal vesicle.

**Femur.** Vert. thigh-bone. Third (counting from body) el. of insect limb. *Joint* of arachnid leg.

**Feral.** Running wild after domestication or cultivation.

**Ferment.** An organized substance that causes change in organic matter. An enzyme. An organic catalyst. *Ex.* yeast. **Fermentation.** Transformation of organic matter as result of action of a ferment. *Ex.* sugar to alcohol; alcohol to vinegar; lactose to lactic acid (souring of milk); ripening of cheese; "curing" of tobacco.

**Fertilization.** Union of two gametes (*q.v.*) and of their nuclei and chromosomes to form a *zygote* (*q.v.*). *Syn.*



fecundation; pollination; synergamy. *See* Cross-f.; Self-f. **Fertilizin.** A substance in unfertilized ova that attracts spermatozoa.

**Fibrin.** Insoluble thready proteid of blood-clot derived from another proteid, **Fibrinogen**, when acted on by *thrombin*.

**Fibula.** The outer "clasp-ing" bone of the leg.

**Field, phy.** Sphere of influence. Space traversed by measurable gravitational, magnetic, and electrostatic forces.

**Filial generations.** The Mendelian symbols for first, second, third, etc., generations of a given mating are F. 1, F. 2, F. 3, etc.; the corresponding parents being P. 1, P. 2, P. 3, etc.

**Filiform.** Thread-like. *Syn.* capillary. **Filopodia.** Slender pseudopodia.

**Filter-passers.** Organisms or viruses sufficiently minute to pass through pores of the finest filter. *Syn.* microhenads. **Filterate.** A solution that has passed through a filter.

**Fimbria.** A fringe or fringe-like border of an opening. *Ex.* mouth of mammalian oviduct or of molluscan siphon.

**Fin.** A membranous, spine-supported, paddle-like, propelling, and balancing organ of fishes. There are two kinds: *median* (dorsal, anal, and caudal fin) and *paired* (two pectoral, corresponding to arms, and two ventral, corresponding to legs). *See* Tail-f.; Homo-, Hetero-cercal; Basi-, Mixopterygium.

**Fire.** Rapid oxidation accompanied by light and heat.

**Fish.** An aquatic, cold-blooded, water-breathing,

gilled vert. with limbs represented by fins. There are 12,000 species. **F.-lice.** Degenerate, parasitic, crustaceans, mostly copepods, found on skin and gills of fishes.

**Fission.** Reproduction by the splitting of a single cell usually into two, but sometimes [brood-formation (*q.v.*)] into many, daughter-cells. *Syn.* cell-cleavage; schizogenesis. **Fissiparous.** Reproducing by fission. **Fissipedal.** Having digits separate to base. *Ex.* dog, cat, bear.

**Fistula.** A long, narrow passage leading to exterior from an abscess-cavity.

**Flabellate, -iform.** Fan-shaped. **Flabellum.** Any fan-like organ—*e.g.*, of epipodite, exite, or madrepor.

**Flagellates.** An O. of protozoa the members of which carry from one to four long cilia or flagella. Cert. ciliated thallophytes—*e.g.*, algæ. **Flagelliform, -ispore, -ula.** A ciliated spore. A zoospore. *See* Brood-cell. **Flagellum.** The whip-like swimming-organ or cilium (*q.v.*) of spermatozoa, protozoa, bacteria, zoospores, flagellates, etc. *Syn.* puls, tract-ellum. *App.* any long, slender appendage.

**Flame.** A luminous mass of gases undergoing oxidation. **F. cells.** Cells of excretory system of cert. worms the cilia of which give them a flickering appearance.

**Flat-worms.** Platyhelminthes and planarians. They number 4,500 species (*q.v.*).

**Flavescent.** Yellowish.

**Flea.** A wingless, blood-sucking, laterally-compressed, insect of the O. Aphaniptera.

**Flexor.** A muscle that approximates parts and "bends" a joint. *Opp.* extensor. **Flexuous.** Curving in a sinuous manner. **Flexure.** A curve or bend.

**Flight.** A mode of passage through the air by means of wings (modified fore-limbs in birds). It originated in a passive or gliding flight as in that of the extinct archæopteryx or the existing flying-fox, and became specialized as the sustained movements of flying birds.

**Floating ribs.** Ribs (*q.v.*) (11th and 12th pairs in man) not connected anteriorly with sternum.

**Flocculus.** Any cloud- or wool-like body. A region of incandescent H and Ca vapour in sun's atmosphere.

**Flora.** Plants, especially those peculiar to a region or period. *Cf.* Fauna. **Floret.** One of the small, individual flowers of a composite inflorescence.

**Flower.** The reproductive part of a seed-pl. A shoot of a sporophyte modified for reproductive purposes. The metamorphosed reproductive shoot of gymnosperms and pteridophytes.

A typical seed-plant flower consists of a protective envelope, or *perianth*, sometimes specialized into *calyx* (with *sepals*) and *corolla* (with *petals*), the *androecium* (= *stamens* or *microsporophylls* carrying *microspores* or *pollen-grains*) and a *gynæcium* or *pistil* (= *carpels* or *megasporophylls* containing *ovules* each with its *megaspore* which, when fertilized by a microspore, becomes the *embryo* within a *seed*). See Epi-, Hypo-, Peri-gynous; Actino-, Zygo-morphic; Cleistogamy; Heterostylous; Diclinal; Mono-, Di-, Tri-ocious; Polygamous; Pleiotaxy.

**F., female.** *f.* bearing pistil but not stamens. **F., hermaphrodite.** *f.* bearing stamens and pistil. **F., male.** *f.* bearing stamens but not pistil.

**Fluid.** A substance the particles of which can easily move about and change their relative positions and which, in the mass, can readily flow and, when at rest, assume a surface all points of which are equidistant from the earth's centre.

A fluid is a non-solid, but not necessarily a non-liquid, for whereas a liquid is distinct from both gas and solid, a fluid may be either a liquid or a gas.

**Fluke.** The leaf-like, final stage of a trematode, whose life begins as a free-swimming embryo, passes on to *sporocyst*, worm-like *redia*, and *cercaria* stages, the last spent within a water-snail, and finally the fluke stage within the liver of cattle or man.

**Fluorescence.** Emission of unpolarized light of a longer w.l. and lesser frequency to the w.l. and frequency of a radiation being absorbed at the time of emission. *Cf.* Phosphorescence. See Radiation; Resonance. Luminescence; Opalescence (S.L.).

**Fluorine, ch. el. F.** Gas. *At. no.* 9; *at. wt.* 19.000.

**Fluviatile.** *Per.* or living in or near streams.

**Flux.** Flow. Rate of flow. A substance promoting fusion.

**Focus.** (1) Point at which convergent rays (light, heat, sound) meet after reflection or refraction, or in case of concave lens, the point from which they appear to diverge. **F.** length is the distance of the f.

from the surface of the lens or reflector. (2) The point so related to a conic section and a *directrix* that the ratio of the distance between any point of the curve and the f. to the distance of the same point from the directrix is constant. In the *ellipse* there are two foci and for each this ratio is less than unity; in the *parabola* there is one f. and the ratio is unity; in the *hyperbola* there are two foci and the ratio is greater than unity.

**Fœtus.** The intra-uterine stage succeeding the embryo stage. In man the developing organism is an embryo up to the 7th week and a fœtus from the 7th week to birth.

**Fog.** Minute liquid droplets (e.g., of water) suspended (q.v.) in a gas (e.g., gases of air). A *cloud* is fog at high altitudes, a *fog* is cloud at earth's surface. Cf. Steam; Vapour.

**Foliaceous.** Leaf-like. **Foliate.** *Per.* or resembling leaflets. **Foliola.** A leaflet or small leaf-like structure. **Foliose.** With many leaves. **Folium.** A leaf or leaf-like part or organ.

**Follicle.** A capsule, small cavity, sac, or sheath. A dry, dehiscent fruit in which pericarp is formed from one carpel and opens along a margin to liberate seeds; it differs from a pod (legume) in being dehiscent by only one suture. A group of follicular cells. See Graafian f.; Hair f. **Follicular cells.** A circle or "nest" of small cells surrounding immature ova.

**Fontanelle.** A gap, of which there are six, in the infantile skull closed by membrane.

**Food.** Materials which, changed and absorbed, repair and build up protoplasm. There are three main types: (1) *proteins*, containing the els. C, H, O, N, S, P, Fe; (2) *carbohydrates* containing C, H, O, and (3) *fats*, containing C, H, O. See Calorie; Procto-, Stomo-dæal. **F. vacuole.** A primordial organ of digestion consisting of an enzyme-filled cavity that forms around food-particles within the endosarc of protozoa, protophytes, and cells generally. Contractile vacuole (q.v.).

**Foot.** (1) Terminal part of leg; insect tarsus; muscular protrusion on ventral part of mollusc; tube-foot of echinoderm; any support or base of a structure—e.g., of sporophyte; an embryonic nourishing organ of ferns. See Meta-, Para-podium. (2) Measure: 12 ins. or  $\frac{1}{3}$  of a yard; 0.30479449 metre; 304794 microns; 304,794,490 millimicrons. **F., cubic.** 1728 cub. ins.; 28316.1 c.c.; 6.2321 galls. (water). **F.-pound.** Unit of energy and work. The work done in lifting 1 lb. weight through 1 vertical ft. 1 f.p. =  $1.356 \times 10^7$  ergs. **F.-poundal.** Unit of work. Work done when a force of 1 poundal acts through a distance of 1 ft. It = 421,402 ergs; or it = a ft. lb. div. by acceleration of *g*. (= 32.16) expressed in ft. per sec. per sec. **F., square.** 144.0 sq. in.; 0.0929 sq. metre.

**Foramen.** An orifice. An aperture in a bone, membrane, or ovule. **Foraminifera.** An O. of rhizopod protozoa usually possessing calcareous shells with perforations through

which pseudopodia can be thrust.

**Force.** Efficient action. That which changes or tends to change the state of rest or of motion of a body. The cause of motion, of resistance to motion, or of arrest of motion. The cause of the acceleration of movement of bodies. The prototype of *f.* is *weight*, and we can appreciate *f.* only through our muscles. The *magnitude* of a *f.* is *mass multiplied by acceleration*, and its *direction* is in the direction of the acceleration of the centre of mass of the body. *f.* differs from matter, momentum, and energy, in that there is *no conservation* of it, it disappears after its effect is produced. The *unit* of *f.* is the *dyne* (*g.v.*); the practical unit is 1 gramme wt. = 980.616 dynes at sea-level and lat. 45°. See Dynamics; Statics.

**Forci-pate, -pated, -pulate.** Forceps-like.

**Fore-brain.** The sensory part of the nervous system which arises from the ant. extremity of the embryonic neural tube. It is the foremost of the three primary vesicles of the developing embryonic brain. In the 4th week the human *f.-b.* resembles the *f.-b.* of the adult fish. *Syn.* central hemispheres. The thalamencephalon and telencephalon.

**Forficate.** Notched.

**Form, zoo.** The shape of an an. is a product of two variables: protoplasm and environment. The three main types of *f.* are: *radial symmetry* (jelly-fish); *asymmetry* (snail); *bilateral symmetry* (man). **Formative.** Capable

of, or conducting towards, growth and development. **F. centre.** A nucleus. **F. disc.** The germinal disc. **F. material.** Protoplasm, but especially the area of cells represented by the daughter-cells of the zygote on top of the yolk, which cells initiate the embryo. *Syn.* *plasson*; *gametoblast*. See Segmentation.

**Formula.** A symbolic expression of a generalization, principle, or constitution. *Ex.*  $n(C_6H_{10}O_5)$  is a formula of starch.

**Fornicated, bio.** Vaulted, arched.

**Fossil.** The metamorphosed remains, or imprints of remains, of once-living things in the earth's crust.

**Fossorial.** Digging or burrowing.

**Fossulate.** Having hollows or grooves.

**Fourth dimension.** A dimension which, added to the ordinary, sensible, three dimensions, length (*l*), breadth (*b*), and depth (*d*), imparts a 4-dimensional sense. Space, on this view held by cert. scientists, is regarded as a 4-dimensional *space-time-continuum*, the *el. time* being added to *l*, *b*, and *d*. **Fove-a, -ola.** Any small depression—*e.g.*, that at leaf-base (quill-wort) which lodges a sporangium. **Foveolate.** Pitted.

**Free-central placentation, bot.** *App.* placenta that is not connected with walls of ovary, but is fixed to an extension of the floral axis. Fixation of ovules to central axis of ovary.

**Free-Martin.** A mammal having the internal sex-organs m., the external *f.* A hermaphrodite.

**Freezing.** Changing of a liquid to the solid state by lowering the temp. **F. point.** The temp. at which *any* liquid turns solid. Thus, nitrogen freezes at  $-210^{\circ}\text{C}$ ., mercury at  $-39^{\circ}\text{C}$ ., water at  $\pm 0^{\circ}\text{C}$ ., and iron at  $+1505^{\circ}\text{C}$ . See Temperature.

**Frenulum.** Any membranous fold. Retinaculum (*q.v.*).

**Frenum.** Any fold of membrane—*e.g.*, that below tongue.

**Frequency.** Vibrations, oscillations, or cycles per sec. The no. of complete current-cycles per sec. produced by an alternating-current generator. The rapidity of variations of electromagnetic waves. Since the vel. of all such waves is the same (300,000,000 metres per sec), the f. is  $300,000,000 \div \text{w.l. cycles per sec.}$  *Syn.* periodicity.

**Frog.** (1) A tailless amphibian. (2) An elastic pad in middle of sole of foot of equines.

**Frondesce.** To put forth leaves.

**Fructose.** Fruit sugar.

**Levulose.** There are three optical varieties.  $\text{C}_6\text{H}_{12}\text{O}_6$ .

**Fruit, bot.** Any product of fertilization, with its modified envelopes and appendages. The ripened ovary of a seed-pl. A berry. Caryopsis. See Capsule; Dehiscence; Drupe; Follicle; Legume; Mericarp; Pericarp; Lomentum; Samara; Schizocarp; Siliqua; Sorosis.

**Frustule.** Siliceous shell of diatom.

**Frustum.** That part of a cone next the base formed by cutting off the apical part by a plane parallel to base.

**Frut-escens, -icose, -iculose.**

Resembling a shrub or small shrub.

**Fucivorous.** Eating seaweed. **Fucoid.** Resembling seaweed. **Fucus.** Wrack; an alga of the brownish-red seaweed type.

**Fugacious, bot.** Falling off early; evanescent.

**Fulcrum, phy.** The supporting point of a lever. *Bio.* Any supporting structure such as a stipule, spine, or scale.

**Function.** (1) The natural, proper, and often specialized action of an organ. (2) A quantity so related to another quantity that change in the one involves change in the other. Thus circumference is a function of diameter, and diameter a function of circumference. **Functional.** Having a special activity and serving a useful purpose. Also *app.* diseases the symptoms of which cannot be referred to any definite lesion. *Opp.* organic disease.

**Fundament.** (1) The aboral aperture or anus. (2) An anlage. **Fundamental.** Foundation. Basis. Primal. Situated at the bottom or existing at the beginning. The ultimate component of a substance as such, or its ultimate el. or unit. The basic el. of a complex wave or sound. The note given out when a wire vibrates as a whole—*i.e.*, exclusive of all secondary vibrations; the lowest note of a chord. *Cf.* Overtone. **Fundamentalism.**

The doctrine that accepts unreservedly the Biblical account of the creation of man and the universe and which rejects all modernistic teaching.

**Fundiform.** Like a sling.

**Fundus.** Bottom or base of an organ. Posterior part of eyeball.

**Fungus.** *Cl.* of thallophytes, including moulds, rusts, smuts, mushrooms, puff-balls, toadstools, yeasts, and bacteria. Fungi lack chlorophyll and are dependent on other organisms (living or dead) for food-supplies. In life habit they are saprophytic (bacteria, *e.g.*), parasitic (wheat rust, *e.g.*), or symbiotic (lichen, *e.g.*). See Hypha, Mycelium. **Fungi-colours.** Parasitic on fungi. *Per.* symbiotic fungi. **Fungi-form.** Mushroom-shaped. **Fungivorous.** Feeding on fungi. *Syn.* mycetophagous. **Fung-oid, -ous.** Resembling fungi. *Syn.* mycetoid.

**Funicle.** Stalk of ovule. Any fibrous strand—*e.g.*, f. in brain or in zoecium of molluscoidea. **Funicular.** *Per.* funicle. Consisting of bundles of fibres.

**Funnel, bio.** A siphon, hypopharynx, infundibulum, corolla.

**Furca.** Any forked process, especially that in proboscis of flies or on abdomen of crustaceans. **Furciferous.** Armed with a forked appendage. **Furcula.** The united collar-bones of cert. birds. The "merry-thought."

**Fuscin.** A brown pigment of the retina.

**Fusiform.** Tapering at each end. Spindle-shaped.

**Fusion.** Process of passing from solid to liquid state, especially of relatively hot bodies. Act of blending and uniting. **F., latent heat of.** Heat absorbed by a body, and not indicated by a thermometer, in passing from a solid to a liquid state. *Syn.* l.h. of melting.

*Ex.* A gramme of water at 80° C. mixed with a gramme of water at 0° C. produces 2 grammes of water at 40° C., because 80 calories are now spread through 2 grammes of water. But a gramme of water at 80° C. mixed with a gramme of ice at 0° C. produces 2 grammes of water at 0° C., because 80 calories are used up in melting the solid. The l.h.f. of water is 80.03, of silver 21.07, of lead 5.37. See Solidifying point.

**F.-nucleus.** The nucleus formed by fusion of one of the two gametes of a pollen-grain with the secondary nucleus and which, by successive divs., forms the endosperm. A zygote nucleus.

**Fusulæ.** Projections on the turret-like spinnerets of spiders upon which open the tubes of the spinning-glands. When very large they are termed *spigots*.

## G

**Gadolinium, ch. el.** Gd. Metal. *At. no.* 64; *at. wt.* 157.3.

**Galactase.** A proteolytic enzyme in milk that hydrolyzes proteins. **Galactophorous.** Lactiferous (*q.v.*). **Galactose.**

*Syn.* lactose (*q.v.*). **Galactosis.** Milk-formation. *Syn.* lactosis.

**Galeopithecus.** The flying "lemur." The largest known insectivore, akin to bats and lemurs.

**Gallinaceous.** *Per.* an O. of birds, including fowl, pheasant, etc.

**Gallium, ch. el.** Ga. Metal. *At. no.* 31; *at. wt.* 69.72.

**Gallon.** One g. (*Br.*) of water at 15° C. weighs 10 *lbs. av.* and occupies 0.16054 *cu. ft.* or 277.3 *cu. ins.* It is = 4.54596 litres or 4545.96 *c.c.*, or 160 liquid ozs. (*Br.*), or 4.0 quarts or 8 pints. 1.0 g. *Br.* = 1.20094 galls. *U.S.*

**Galton's law.** A person derives  $\frac{1}{2}$  his characters from the two parents ( $\frac{1}{2}$  from each);  $\frac{1}{4}$  from his grandparents ( $\frac{1}{4}$  from each);  $\frac{1}{8}$  from his great-grandparents ( $\frac{1}{8}$  from each); and so on, the series being  $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots$  etc. = 1.

**Galvanometer.** An instrument for detecting electric currents consisting of a magnetic needle within a coil of wire through which flows the current to be measured. **Galvano-tactism, -tropism, bio.** Response to electric stimuli or reaction to electric currents by definite movement or orientation—e.g., ciliates orient their long axes parallel to lines-of-force and then swim towards kathode—they are negatively galvanotropic.

**Gametangium, bot.** A structure producing sexual cells. **Gamete.** A m. or f. sex-cell. It arises from a gametocyte. *Syn.* conjugant; gonium; gonidium; gonoblast; nematogone; pollinoid; sperm-cell; spermatozoon; thelyblast. Unfertilized egg or ovum, etc. *See* Syngamy. **Gametic coupling.** Linkage (*q.v.*). **Gametid, -oblast.** Formative substance of sex-cell. An immature gamete. A plasson;

gametocyte; primary sporoblast. **Gametocyst.** Cyst containing gametes. **Gametocyte.** A gametid (*q.v.*). Mother-cell of gamete. Cell arising from a micromerozoite. *Syn.* gametogonium; gamont; microgonidium; sporont. **Gametogenesis, -geny.** Formation of gametes and arrangement of genetic chromosomes within them. **Gametogonium.** *Syn.* gametocyte (*q.v.*). **Gametophore.** Gametangium-bearing part of gametophyte. **Gametophyll.** A macro- or microsporophyll. A sex-organ-bearing leaf. **Gametophyte, bot.** The sex-organ bearer in alternation of generations (*q.v.*). *See* Brood-cell.

The sexual g. stage alternates with the asexual sporophyte (*q.v.*) stage. The g. cell has half the number of chromosomes borne by the sporophyte cell. In liverworts and mosses the g. arises from a protonema and produces the antheridium and archegonium. In ferns the g. is represented by the thallus. *Syn.* oophyte; pollen-grain; prothallus, etc.

**Gamic.** *Per.* fertilization.

**Gamma rays.** Very short-wave radiations (short X-rays) emitted during disruption of atomic nuclei of radioactive bodies. w.-l. 0.03 to 1.4 A.U. Freq.  $10^{20}$  to  $2 \times 10^{18}$ . *See* Radiations; Waves.

**Gamobium.** The sexual generation in metagenesis. *Cf.* Agamobium. **Gamodesmic.** Having fused (not separate) vascular bundles. **Gamogastrous.** *App.* pistil with united ovaries but free styles and stigmata. **Gamogen-esis, -y, gamogony.** Sexual reproduction. *Syn.* sporogony. **Gamont.** *Syn.* gametocyte (*q.v.*). **Gamopetal-ae, -ous.** A div.

(or *per.*) of Dicotyledons. Flowers (or *per.*) in which petals are united. *Syn.* mono-petal-æ, -ous. **Gamophyllous.** Having united perianth leaves. *Syn.* mono-, sym-phyllous. **Gamophyte.** Sexual element producing oo- and spermo-phytes. *Oo- plus* spermo-phytes in unisexual thallus. **Gamosepalous.** With coherent sepals. *Ex.* rose. *Syn.* mono-sepalous. **Gamostele.** The fused steles of a polystelic stem surrounded by pericycle and endodermis. **Gamotropism.** Mutual attraction of gametes.

**Ganglion.** A nerve-centre lower than or subordinate to a brain. An aggregation of nerve-cells that receives and distributes nerve-impulses. **Ganglioblast.** Mother-cell of **Gangliocyte.** A ganglion cell outside the central nervous system. **Ganglioneuron.** Nerve-cell of ganglion.

**Ganoids.** Ancient O. of fishes of Devonian-Carboniferous ages with sturgeon as a modern representative. **Ganoin.** Glistening enamel-like material of fish-scales.

**Gas.** (1) A fluid state of matter which, unconfined, has neither definite shape nor vol., but, confined, takes the shape and vol. of the container. (2) A gaseous substance at a temp. above its critical temp. *Cf.* Liquid; Solid.

A g. to be liquefied must be subjected to *cooling* and *pressure*. Above 31° C., CO<sub>2</sub> is a g., below 30-9° C. it is a *vapour* (*q.v.*).

**G.-gland.** Any g.-producing organ, especially the oxygen-excreting part of fish's air-bladder.

**Gasteromycetous.** Having

spores developed within a peridium. **Gastero-, gastro-poda.** *Cl.* of molluscs with expanded or creeping foot. *Ex.* snail. **Gastræa.** Hypothetical two-cell-layered ancestor of metazoa. **Gastræads.** Modern gastræa-like an. **Gastræum.** Ventral aspect of an an. **Gastric.** *Per.* stomach. **Gastrin.** A hormone produced by action of saliva on stomach. **Gastrocentrous.** *App.* vertebrae the centra of which are formed by pairs of intervertebra. **Gastrocel.** Archenteron (*q.v.*) of gastrula. **Gastrolith.** Any swallowed stone. **Calcareous** matter in gizzard of crustaceans. **Gastropoda.** *Syn.* gasteropoda (*q.v.*). **Gastropores.** Large apertures in hydroids of corals. *Cf.* Dactylopores. **Gastrostege.** A ventral scale. **Gastrozoid.** Nutrient individual of coelenterate colony. *Cf.* Zooid. **Gastrula.** The two-cell-layered sac formed by invagination of a blastula; it has a common entry and exit, the blastopore, leading into and out of the archenteron (*q.v.*). *See* Egg. **Gastrulation.** Formation of gastrula from blastula.

**Gauss, elec.** Unit of flux-density. One Maxwell (*q.v.*) per sq. cm.

**Geitonogamy.** Fertilization of one flower by another on same pl.

**Gel.** A colloid in a state of coagulation or precipitation. *Syn.* coagulum. *Cf.* Sol. **Gelatin.** A jelly-like derivative of collagen.

**Gemma, -ule.** Any bud or outgrowth of a pl. or an. A cup-shaped body in liverworts. A pangen (*q.v.*).



**Gemminate.** Growing in pairs. *Syn.* **binate.** **Gemmiferous.** Having paired flowers. **Gemmparous.** Bud-bearing.

**Gena.** Cheek, or side of head.

**Gene.** One of the paired hereditary units which control the appearance of definite characters and which are carried at definite *loci* in paired *chromosomes*. *See* **Genomere.** **G.-complex.** Interacting system formed by the combined genes constituting an internal environment wherein any given factor operates.

**Genealogy.** Origin of an individual and its ancestors.

**Generalization.** Apprehension of the one in the many. A principle applying to a large No. of facts. Deduction of a general conception from a particular fact. *Bio.* Combining characters of two or more groups. **Generations, alternation of.** The cycle of generations in an organism's life-history. *See* **Alternation.** **Generative cell.** (1) The smaller of two cells into which a pollen-grain divides. (2) Either of the two cells into which this smaller cell sub-divides. (3) A spermatozoid or gamete. (4) In pinus the cell arising from the antheridial cell. **Generator.** Any machine that converts mechanical into elec. energy. A dynamo or alternator.

**Genesis, bio.** Origin and development of cells, organs, organisms, species, etc. **Genetic.** *Per.* heredity. **Genetics.** Study of heredity and variation. **Genotype.** A group of individuals similar in genetic constitution—i.e., having characters handed down from, and

through, germ-cells. *Syn.* **genotype, -plast.** *Cf.* **Phenotype.**

**Geniculation.** A joint.

**Genital pouch.** Any recess acting as an adjunct to genital aperture—e.g., *Bursa copulatrix*. **Genitocœl.** A brood-cavity.

**Genoblast.** A sex-cell. **Genomeres.** Hypothetical fundamental units of a gene (*q.v.*). **Genoplast.** *Syn.* **genotype** (*q.v.*). **Genotype.** *Syn.* **genotype** (*q.v.*). **Genus.** A group of closely-related species. *See* **Classification.** **Genys.** The lower jaw.

**Geobiosis.** Terrestrial life. **Geoblast.** A plumule (*q.v.*) with underground cotyledons. **Geocarpic.** Having fruits that mature underground. **Geology.** Study of the earth's crust. **Geomalism.** *Syn.* **geotaxy** (*q.v.*). **Geophilous.** Feeding on earthy matter. **Geophyte.** A terrestrial pl. **Geotactism, -taxis, -taxy.** Orientation to gravity. Thus a root, a stem, and a horizontal branch are examples, respectively, of positive-, negative-, and dia-geotropism. *Syn.* **barotaxy; geo-malism, -tropism.** *See* **Apo-, Pro-geotropism.** **Exo-tactism, -tropy.** **Diageo-tactism, -tropy, etc.** **Geotonus.** Normal position in relation to gravity. **Geotropism, -y.** *Syn.* **geotaxy** (*q.v.*). *See* **Apogeotropism.**

**Gephyrocercal.** Having dorsal and anal fins confluent at reduced end of vert. column.

**Geratology.** Study of senescence and decadence.

**Germ.** A microbe, spore, seed, unfertilized egg, or any part of an organism capable of developing into a new organism. **G. cell.** A gamete or sex-

cell. An unfertilized ovum. A spermatozoon.

**Germanium**, *ch. el.* Ge. Metal. *At. no.* 32; *at. wt.* 72.60.

**Germarium**. *Syn.* **Germen**. A collection of undifferentiated gametes. A spermary. An ovary.

**Germinal disc**. The active protoplasm in yolk at the an. pole of a segmenting egg which originates the embryo. *Syn.* blastoderm; formative disc. **G. epithelium**. A layer of cells covering early mammalian ovary from which arise the primordial ova and follicular cells. **G. layers**. The earliest layers of cells, the epi-, hypo-, and (later) meso-blast, out of which the body develops. **G. selection**. The struggle for existence among, with survival of the fittest of, germ cells. **G. spot**. The nucleus of an ooplasm or nucleolus of an ovum; nucleus of g. vesicle. **G. vesicle**. Nucleus of ovum before expulsion of polar bodies. The oosphere. Blastocyst. After expulsion of the two polar bodies the g.v. is known as the female pronucleus. **Germiparity**. The first, and non-differentiated stage in the development of the sex organs in birds and mammals, in which there are three stages—viz.: (1) germiparity; (2) hermaphroditism; (3) unisexuality. Reproduction by germ formation. **Germ-plasm**. The distinctive part of the nucleus of a mature gamete (*q.v.*) which is the bearer of inheritable properties. One portion of it helps to build up a new *soma*, while another portion is set aside to form the g.-p. of the next generation.

**Syn. idioplasm. G.-tube**. A pollen-tube.

**Gerontic**. *Per.* senescence.

**Gestation**. Period between fertilization and birth which, roughly, is in terms of size; thus, in days, the g. period is for: mouse, 21; hare, 28; marmot, 35; dog, 60; pig, 119; sheep, 150; man, 280; ass, 301; horse, 325; rhinoceros, 550; elephant, 800–900.

**Gill**. (1) Four fluid ozs (*Br.*) or 142.07 c.c. (2) Any plate-like outgrowth. (3) Lamella of mushroom. (4) The respiratory organ of aquatic verts. A ctenidium. **G.-arch**. A branchial arch; part of skeleton of a functional fish-gill. **G.-book**. A respiratory organ of aquatic arachnoids. **G.-cleft**. A branchial cleft. **G.-cover**. *Syn.* operculum (*q.v.*). Branchiostegite. **G.-rakers**. A sieve-like mechanism of the branchial arches of fishes that prevents food-particles escaping from throat, and particles from without entering and clogging the g.-filaments. **G.-slits**. Paired perforations in pharynx leading to exterior. They are permanent in lower verts., but present only in embryos of higher verts. *Syn.* branchial clefts.

**Ginglymus**. A hinge-joint.

**Gizzard**. A muscular, stone-containing, grinding organ of digestion. *Syn.* mastax; proventriculus.

**Glacial period**. The period comprised by all the glacial epochs from the pre-Cambrian to quaternary times, during each of which a much larger portion of the earth was under ice than is at present the case.

**Glacier.** A slow-moving river of snow-derived ice.

**Gland.** A collection of cells which produce and liberate specific chemical solutions. *G.*, ductless. *See* Ductless. *G.*, green. An excretory (kidney) organ of crustaceans. *G.*, hermaphrodite. An ovo-testis that develops ova and sperms. *G.*, oil. *Syn.* elaeodochon. Preening *g.* Uropygial *g.* Oil-secreting *g.* near root of tail in birds. *G.*, hibernating. A mass of fatty tissue drawn upon for food during hibernation. *G.*, preening. Oil-*g.* (*q.v.*). *G.*, spinning. The *g.* in spiders and caterpillars that forms liquid silk. *G.*, uropygial. Oil-*g.* (*q.v.*).

**Glaucothoe.** Larval stage of hermit-crab.

**Globigerina ooze.** Foraminiferous sea-bottom mud.

**Globulin.** A proteid.

**Glochidiate.** Having barbed hairs. **Glochidium.** A larva of f.-w. mussels.

**Gleca.** A sticky secretion exuded by protozoa.

**Glomerulus.** A compact cluster or network. A cyme.

**Glossophagine.** Catching food with the tongue. **Glossopodium.** A sheathing leaf-base. **Glossotheca.** A proboscis cover.

**Glucose.** Grape-sugar,  $C_6H_{12}O_6$ . *Syn.* dextrose.

**Glume.** A chaff-like, scaly bract at base of grass inflorescence. *Cf.* Palea.

**Gluten.** A gelatinous substance derived from cereal seeds.

**Glycer-in, -ol.** A viscid, sweet, triatomic alcohol in oils and fats.  $C_3H_5O_3$ .

**Glycogen.** A carbohydrate

storage-product in pl. and an. ( $C_6H_{10}O_5$ )<sub>n</sub>.

**Gnathic.** *Per.* jaw or chin.

**Gneiss.** A laminated metamorphic rock, quartz, felspar, hornblende, and mica. *Cf.* Granite.

**Gold, ch. el.** Au. Metal *At. no.* 79; *at. wt.* 197.200.

**Golgi bodies.** Rod-like and reticular constituents of cert. cells. *See* Chromo-, Dictyosome.

**Gonad.** An organ in which gametes are formed. A sex-gland, testis, ovary, etc.

**Gonadotropic.** *App.* substances that influence the gonads.

**Gonangium.** Perisarc around blastostyle of hydroids. *Syn.* gonotheca; teleophore; perigonium. **Gonapophyses.** Components of sting or ovipositor.

**Gonia.** *Syn.* gonidia. Sing. gonidium. Primitive sex-cells. Non-motile reproductive cells. Oo-, spermo-cytes, sporidia. Undifferentiated gametes.

**Gonidangium.** A structure producing gonidia. *Syn.* gonia (*q.v.*).

**Gonidiophore.** Hypha bearing the gonidangium.

**Gonidiophyll.** A gonidia-supporting gametophyte. **Gonidium.** *Syn.* gonim-oblast, -ium.

One of the filamentous outgrowths of fertilized carpogonium. *See also* pl. Gonidia.

**Gonium.** A gamete (*q.v.*). **Gonimoblast.** Gonimium.

Filamentous outgrowths of fertilized carpogonium. **Gonimium.** A small gonidium (*q.v.*).

**Gonimoblast.** Gonidium (*q.v.*). **Gonoblast.** A gamete.

**Gonoblastid.** A blastostyle. **Gonocalyx.** The "bell" of a medusiform. **Gonophore.**

**Gonocheme.** A gamete-bearing medusoid. **Gonochorism.**

Sex-differentiation. **Gonocœl.**

A cavity the wall of which produces sex-cells. **Gonocyte.** Mother-sex-cell. **Gonodendron.** A structure bearing gametes. A branching blasto-style. **Gonoduct.** A gamete-conveying tube. *Syn.* ovi-, spermo-duct. **Gonomery.** Segregation throughout life of an individual of chromosomes of m. parent from those of f. parent. **Gonophore, zoo.** The "individual" gonad-bearing zooid. *Bot.* An elongation of thalamus between corolla and stamens. *Syn.* gono-some, -zooid. **Gonoplasm.** The reproductive part of protoplasm. **Gonopore.** A genital aperture. **Gonosome.** The collective zooids of a gonophore. **Gonosphaerium.** An oosphere. **Gonostyle.** A sexual palp. A blastostyle. **Gonotheca.** *Syn.* gonangium (*q.v.*). **Gonotocont.** *Syn.* Auxocyte (*q.v.*). **Gonotome.** The ventral segment that contains the gonad primordium. **Gonozooid.** *Syn.* gonophore (*q.v.*). **Gonys.** Lower part of bird's bill.

**Graafian follicle.** A collection of cells surrounding mammalian ovum while within the ovary. *See* Discus.

**Grain.** 0.0022857 oz. av.  $1.42857 \times 10^{-4}$  lb. av. 0.064798918 gramme.

**Gramme.** Unit of mass (constant) and weight (variable). 980.616 dynes. 1 c.c. of water at 4° C. 15.432356 grains. 0.0352739 oz. av. 0.00220462 lb. av. 1000.0 milligrammes.

**Granite.** Plutonic rock. Quartz, felspar (ortho clase), and mica. *Cf.* Gneiss.

**Grape-sugar.** Glucose (*q.v.*).

**Graptolite.** A fossil hydroid.

**Gravitation.** That which gives to terrestrial bodies their

*weight.* *See* Gravity, centre of (*S.L.*).

It is the apparent force of attraction between one particle of matter and every other particle of matter in the universe. The force varies *directly* as the product of the two masses and *inversely* as the square of their distance apart reckoned from their centres of mass, and its direction is along the straight line joining the centres.

**G., constant.** Acceleration produced by the attraction of unit mass at unit distance; it is  $= 6.6579 \times 10^{-8}$  in c.g.s. units.

**Gregarina gigantea.** One of the sporozoa; the largest unicellular an. known.

**Grey matter, zoo.** The nerve-cell-containing part of the brain and spinal cord which receives and discharges nervous impulses; in the cord it is *inside* the white matter (nerve-fibres), in the brain it is *outside* the white matter. *Syn.* cortex.

**Growth.** Increase of mass characteristic of protoplasm and crystals.

In crystals g. is due to the addition of material to the surface, in protoplasm to addition of material to all parts. Since the *surface* of a sphere increases as the *square* of its diameter, and the *contents* as the *cube*, there is a tendency during the g. of a cell for the innermost parts to get starved, hence the necessity for cell-division. *Cf.* Apposition and Intussusception.

**Guanophore.** A cell containing guano pigments (*guanidin*, *guanin*, etc.). An iridocyto. A yellow pigment cell.

**Guard-cells.** Two chloroplast-containing cells of leaf-stoma.

**Guest, zoo.** An insect living in nest of another species. A myrmecophil.

**Gula.** Median ventral part of insect head.

**Gurwitsch rays.** Mitogenetic

radiations alleged to be emitted by living matter.

**Gymnanthous.** Having no floral envelope. Achlamydeous. **Gymno-ari, -an, -um.** An ovary not embraced by oviducts; a free, unenclosed, gonad. *Cf.* Cystoarian. **Gymnoblasic.** Devoid of gono- and hydro-theca. **Gymnocarpous.** Having "naked" uncoiled fruit or apothecium. **Gymno-cyte, -cytode.** A "naked"—i.e., unwalled—cell or cytode. **Gymnogenous.** *App.* animals that are born naked. **Gymnogynous.** Having an exposed ovary. **Gymnoplant.** Primal, indefinite, protoplasm. **Gymnosperm.** A naked-seeded pl.—i.e., a pl. with ovules not enclosed in a true ovary or seed-vessel. *Ex.* pine. **Gymnosperm.** An unenclosed spore or gamete. **Gynæcium.** f. floral organs. **Pistil.** Ovary. **Gynæcomorph.** A m. that resembles a f. **Gynæcophore.** A groove in cert. m. in

which the f. is carried. **Gynandrium.** Having fused stamens and pistil. **Hermaphroditism.** **Gynandromorph.** An individual of a bisexual species that has m. and f. characters. **Gynandrophore.** A sporophyll-bearing organ. **Gynantherous.** Having stamens transformed to pistils. **Gynecomast.** A m. with f. breasts. **Gynogenesis.** Development from egg containing maternal chromosomes only. *Opp.* androgenesis (*q.v.*). **Gynogonidia.** f. gametes formed after asexual cell divisions. **Gynophore.** An ovary- or gonophore-bearing organ. **Thecaphore.** **Gynostegium.** A gynæcium covering. **Gynostemium.** A united androecium and gynæcium.

**Gypsophyte.** *Syn.* calicole. Pl. thriving on limy soil.

**Gyroscope.** A disc that can spin about one axis while rotating about two axes perpendicular to each other and to the axis of spin.

## H

**Habit.** Fixed custom or settled disposition. Specific action carried out with increasing ease and skill. *An acquired "action-pattern."* Mode of growth. Manner of life. **Habitat.** Natural place of abode or area of occupation of an an. or pl. *Divs.* are: aerial (birds); arboreal (lemur); fossorial (mole); terrestrial (hare); littoral (seal); aquatic (fish); abyssal (deep-sea organisms); pelagic (turtle); fluviatile (otter).

**Hæckel's law.** Law of Biogenesis (*q.v.*).

**Hæma.** Hema; hemo, hæmata, hæmato, hemato. *Per.* blood.

**Hæmochrome.** Red colouring-matter of blood. **Hæmacyte.** A blood-corpuscle. **Hæmamœba.** A protozoan of blood-corpuscles. The malaria parasite. *Syn.* hæmatocytozoön. **Hæmatin.** Iron-containing pigment resulting from decomposition of hæmoglobin. *Syn.* hæmochromogen. *See* Hæmin. **Hæmatobium.** An organism that lives in blood. *Cf.* Hæmato-cytozoön; -zoön. **Hæmatoblast.** Parent-cell (in

marrow and liver) of red blood-corpuscle. *Syn.* blood-platelet; erythro-, micro-cyte. **Hæmatochrome.** Red pigment of cert. algæ and of eye-spots of flagellates. It is the cause of red snow. **Hæmatocryal.** Cold-blooded. *Cf.* **Hæmatothermal.** **Hæmatocytozoon.** A parasite that lives *inside* a blood-corpuscle. *Cf.* **Hæmatobium.** *Syn.* **hæmamœba.** **Hæmatogenesis.** Blood development. **Hæmatophagous.** Feeding on blood. **Hæmatophyte.** A plant-parasite of blood. **Hæmatopoesis.** Blood formation by bone-marrow, liver, spleen, and lymph-glands. *Syn.* **hæmatosis.** **Hæmatosis.** **Hæmatopoesis** (*q.v.*). **Hæmatothermal.** Warm-blooded. *Cf.* **Hæmatocryal.** **Hæmatozoon.** An *animal* parasite in blood. A hæmoflagellate. *Cf.* **Hæmatobium.** **Hæmin.** **Hæmatin chloride.** **Hæmo-cœl.** A blood-filled space. *Cf.* **Cœlom.** **Hæmocyanin.** A respiratory copper-containing pigment which imparts a blue tint to blood of cert. *invertebrates.* *Cf.* **Hæmoglobin.** **Hæmocytolysis.** Disintegration of red blood-corpuscles. **Hæmoerythrin.** Reddish pigment in blood of cert. *invertebrates.* *Cf.* **Hæmoglobin.** **Hæmoflagellate.** A ciliated hæmatozoon. **Hæmofuscin.** A yellow pigment of extravasated blood—appears in old bruises. **Hæmoglobin.** ( $C_{755}H_{1203}FeN_{195}O_{218}S_3$ .) Red respiratory pigment of venous blood in verts. and a few invertebrates. It is oxygenated in lungs to oxy-h. h. is hæmatin *plus* globulin. *Syn.* **cruorin.** *Cf.* **Hæmo-cyanin,**

**-erythrin;** **Chlorophyll.** **Hæmolymph.** Cœlomic fluid; foetal blood; a precursor of blood. **Hæmolysin.** A substance that dissolves red blood-cells. **Hæmolysis.** The process of dissolving red blood-corpuscles. **Hæmophilia.** A sex-linked *f.-transmitted* character whereby the blood of a m. descendant fails in its normal clotting, and so permits of severe, and often fatal, hæmorrhage from slight wounds. **Hæmoplasmodium.** A unicellular blood-parasite. **Hæmorrhage.** Escape of blood from a vessel. Bleeding.

**Hafnium, ch. el. Hf. Metal.** *At. no. 72; at. wt. 178.6.*

**Hail.** Spherical pellets of ice and compacted snow caused by the sudden freezing of rain-drops. *Cf.* Ice; Snow.

**Hair.** A thread-like outgrowth of epidermis of an an. or pl. *Syn.* **pilus;** **capillus;** originally, in an. it was a "touch-organ," being a modification of the skin "touch-bodies" of reptiles. As "vibrissæ" around mouths of carnivora (*e.g.*, "whiskers" of cat) hairs still retain function of touch. *See* Root; Scale. **H.-cell.** *See* Cell. **H.-follicle.** The receptacle in and from which a h. grows.

**Hallucination.** Perception (*q.v.*) of objects not actually present. *Cf.* Delusion; Illusion.

**Halolimnic.** *App.* marine organisms modified for f.-w. existence. **Halophil-ic, -ous.** Living in salt water. **Halophyte.** A pl. that grows in salt-impregnated soil. **Halo plankton.** *Floating* sea-organisms. *Cf.* Limnoplankton.

**Halteres.** Balancers. Paired pin-like organs of diptera with balancing and sound-perceiving functions.

**Hamuli.** Hooklets, especially terminal ones of feathers.

**Hapalidæ.** O. of *primates*. Marmosets.

**Haplochlamydeous.** Having rudimentary perianth-leaves protecting the sporophylls.

**Haplodont.** Having primitive, simple-crowned, molar teeth (*ex. toothed whale*). **Haploid.** Possessing the typical single set of chromosomes characteristic of mature gamete—*i.e.*, half the somatic No. *Cf.* Diploid. *See* Polyploid. **Haplopetalous, -stemonous.** Having only one row of petals, or one whorl of stamens. **Haplosis.** *See* Diplosis. **Haplotropism.** Response to contact-stimulus. Curvature of pl. towards any solid it touches. *Syn.* thigmotropism; positive stereotropism.

**Hapteron.** "Hold-fast" of pl. Tentacle. **Haptophore.** A toxin molec. in its combining capac. *See* Toxophore.

**Harmonic.** (1) An overtone; a secondary sound-wave c freq. an integral multiple of the fundamental (*q.v.*). (2) Component of an alternating wave.

**Hastate.** Spear-shaped.

**Haustellum.** Insect's sucking proboscis. **Haustorium.** The absorbing organ of parasitic pl. (*e.g.*, in dodder).

**Head.** (1) *Bot.* Capitulum. (2) *Zoo.* The differentiated segments of the leading pole of an an. which are furnished with distance-sense-organs.

**Hearing.** *See* Audibility.

**Heart.** (1) *Bot.* Duramen. (2) *Zoo.* A hollow, muscular,

rhythmically-contracting force-pump circulating fluids through the tissues of an an. In the 5th week the human embryo's h. is arranged like that of a fish (2 chambers); later, however, it becomes 4-chambered with 2 auricles and 2 ventricles.

**Heat.** (1) *Phy.* A form of energy possessed by a body in virtue of the motion of its mols., an energy which can be conducted to other bodies and raise their temp., or can be radiated (as waves) into space. (2) *Bio.* Sensation of warmth. (3) The estrus cycle. *See* Energy; Mechanical; Specific, Molecular. **H. death.** *See* Thermodynamics. **H., latent.** h. that is absorbed by a body but does not raise its temp. **H. of decomposition.** Thermal change occurring when a body is decomposed. It is identical with, but of opp. sign to, the h. of formation (*q.v.*). **H. of formation.** Thermal change occurring when els. combine.

H.o.f. is generally positive, in which case the substance and the reaction are called *exothermic*, occasionally it is negative, the substance and reaction being *endothermic*. *Ex.* the h.o.f. of hydrochloric acid, HCl, is -22,000, of nitric peroxide, NO<sub>2</sub>, is +7,700. On the other hand the h.o.f. of HCl is +22,000, and of NO<sub>2</sub> is -7,700. One gramme of H (*at. wt.* = 1) combining with 35.5 grammes of Cl (*at. wt.* = 35.5) evolve 22,000 gramme-units of h.; 14 grammes of N (*at. wt.* = 14) combining with 32 grammes of O (*at. wt.* = 16) absorb 7,700 gramme-units of h.

**H., unit of.** (1) The h. required to raise the temp. of 1 lb. water through 1° C. (2) The B.Th.U. = the h. required to raise the temp. of 1 lb. water through 1° F. *See* Calorie.

**Heaviside.** *See* Kennelly.

**Hecto.** Prefix denoting 100.  
**Hectocotylus.** A modified arm of m. cuttle-fish laden with spermatophores and capable of being detached and thrust by the m. into the mantle of a f.

**Helicoid.** Screw-like. Curved like a snail shell. Cf. Scorpioid; Spiral.

**Helio-taxis, -tropism.** Reaction of organisms to light stimuli; those that turn or move towards a source of light are positively heliotropic, those that turn or move away from the light are negatively heliotropic. Syn. photo-taxis, -tropism. Cf. Aphelio-, aphoto-, dia-, and selenotropism.

**Helium, ch. el.** He. Inert, light, gas. At. no. 2; at. wt. 4.002. He atom. Consists of 4 protons, 2 nuclear and 2 planetary or valence electrons. Its nucleus is an alpha particle (q.v.).

**Helminthology.** Study of worms.

**Helophyte.** A bog-plant.

**Helolism.** Symbiosis (q.v.) in which one organism enslaves the other.

**Hemichor-da, -data.** A sub-series of vertebrates. Marine worm-like an. in which a notochord is present in fore end of body; type, balanoglossus. They represent a probable link between invertebrates and vertebrates. Syn. enteropneusts. There are 50 species (q.v.). **Hemihedron.** A solid with half the similar parts only of crystal form. Ex. a tetrahedron is contained under 4 only of the 8 faces of an octahedron. **Hemikaryon.** A haploid nucleus. **Hemimetabolism.** (1) Having incom-

plete metamorphosis. (2) Condition of cert. insects (*hemimetabola*) wherein there is no pupal stage—i.e., wherein metamorphosis is incomplete. Ex. cicada, the larva of which is almost like the adult. Syn. ametabolism. Cf. Holometabolism, Homomorphism. **Hemiptera.** An O. of 4-winged insects in which the wings are partially concealed. Includes bugs, lice, aphides, etc.

**Hemocyanin.** Vars. hæmo-, hæmato-(q.v.). A copper-containing respiratory pigment of cert. invertebrates, analogous to hæmoglobin. When oxidized to oxy-h. it imparts a blue tint to the blood. **Hemoptysis.** Expectoration of blood due to bleeding from the lungs.

**Henry.** Unit of inductance. It is = inductance of a circuit in which an E.M.F. of 1 volt is induced by a current varying at rate of 1 ampere per sec., or  $10^9$  (c.g.s.) units of inductance.

**Hepaticæ.** Liverworts.

**Heptad, Heptavalency.** See Valency.

**Hercogamy.** Prevention of self-fertilization.

**Heredity.** The organic relation between successive generations. Germ-protoplasm is the expression, germ-chromatin the seat, of heredity. See Galton; Mendel.

**Hermaphro-dite, -ditism.** A bisexual an. or pl.

An organism (e.g., snail; earth-worm) in which ova and sperms are produced, but at different times so as to prevent self-fertilization. A pl. (e.g., hazel; oak), the flowers of which bear m. (stamens) and f. (pistil) reproductive organs. In man, the embryo is hermaphroditic, but in the adult a true and complete hermaphrodite—i.e., a being bearing testes and ovaries—is probably not known;



the condition is invariably partial. *Syn.* androgynism; gynandrisms. *See* Dichogamy; Free-Martin; Germiparity; Intracellular.

**Herpetology.** Science of reptiles.

**Hertzian waves.** Elec.-mag. (wireless) waves (*q.v.*). Source of short waves, freq.  $3 \times 10^{12}$ – $10^4$ , elec. spark; of long waves, freq.  $10^4$ –100, coil rot. in mag. field; of both wave-types, valve-oscillators. *See* Radiation; Wave; Wireless.

**Hetero.** Prefix denoting other than normal, *opp.* homo.

**Heteroblasty.** Indirect development.

**Heterocercal.** Having an asymmetrical tailfin. *Cf.* Homocercal.

**Heterochromosome.** An atypical chromosome. The sex-chromosome.

**Heterochronism.** Ceno-genetic modifications in embryonic development.

**Heterocel, -ous, -y.** Condition in which articulating surface of vertebra is concavo-convex (saddle-shaped).

**Heterodactylous.** *App.* birds with first two toes directed backwards.

**Heterodont.** *App.* animals with different types of teeth, as incisors (cutting), canines (stabbing), and molars (grinding).

*Cf.* Homodont.

**Heterocécious.** Passing different life-stages in different hosts; monécious and parécious.

*Ex.* puccinia, lives first on barberry, then on wheat; liver-fluke, first on water-snail, then on man.

*Syn.* metécious; heterophagous (*q.v.*).

**Heterogametes.** Dissimilar conjugating gametes.

*Syn.* anisogametes. *Cf.* Isogametes.

**Heterogametic.** Having two types of gametes.

*Syn.* digametic. *Cf.* Homogametic.

**Heterogametic sex.**

Sex with dissimilar sex-chromosomes.

**Heterogamety.** Heterogamy (*q.v.*).

**Heterogamous.** *Per.* unlike gametes; two types of flowers; or indirect fertilization, in or on one organism.

*Cf.* Homogamy.

**Heterogamy.** *Syn.* heterogamety.

Condition of producing dissimilar gametes.

Condition of alternation of generations (*q.v.*). *See* Metagenesis.

**Heterogeneous.** *Syn.* heterotypic.

*Opp.* Homogeneous.

Not uniform in composition and density. *Cf.* Anisotropic.

**Heterogenesis.** Alternation of generations—i.e., sexual crossing alternating with parthenogenesis in a life-cycle.

*Syn.* xenogenesis. Also *app.* abiogenesis.

**Heterogony.** Condition of having two or more kinds of flowers differing in length of andræcium and gynæcium.

Also *app.* alternation of generations.

**Heterokinesis.** Qualitative (differential) division of chromosomes.

*Cf.* Homeokinesis.

**Heterologous.** Non-correspondence of parts.

*App.* cells that differ from parent-cells.

*Syn.* heterotypical. *Cf.* Homologous.

**Heterometabola.** *Syn.* ametabola.

Insects with incomplete metamorphosis.

**Heteromorphosis.** Production of a part in an abnormal situation; regeneration of a new part different from the part lost.

*Syn.* xenomorphosis.

**Heterophag-ous, -y.** Absorption by one organism of another organism of different kind.

*Syn.* heterécious. *Opp.* isophagy.

**Heterophyte.** A pl. dependent on another pl. or an. for food. *Cf.* Autophyte.

**Heteroplasia.** Development of

one type of tissue from another type. **Heteroploid.** Having one chromosome in excess or deficient owing to non-union of a pair during meiosis.

**Heterosis.** Heterozygosis (*q.v.*).

**Heterostylous.** *App.* bisexual pl. with flowers that differ in length of style (*ex.* primrose). *See* Flower.

**Heterosynapsis.** Union of two dissimilar chromosomes.

**Heterotrop-ic, -ous.** *App.* ovule with hilum and micropyle at *opp.* ends in a plane parallel to placenta.

**Heterotypic.** *Syn.* heterogeneous. *Per.* mitotic div. in which daughter-chromosomes remain united; the *first div.* in meiosis. *Opp.* homeotypic. **Heterozygosis.** Cross-fertilization.

Descent from two different varieties, species, or races. *Syn.* heterosis. **Heterozygote.** An organism produced by union of two gametes which differ as regards some particular alternative factor. A Mendelian hybrid with recessive characters. An organism, each cell of which contains genes of an unlike kind—*i.e.*, of a kind that will probably beget unlike characters. *See* Mendelism.

**Heterozygous.** *Per.* heterozygosis.

**Hexad.** *See* Valency. **Hexagynous.** With six pistils.

**Hexamerous.** Arranged in sixes.

**Hexandrous.** *Syn.* hexastemonous. With six stamens.

**Hexaploid.** With six times the normal (diploid) no. of chromosomes. **Hexastemonous.** Hexandrous (*q.v.*).

**Hexavalent.** *See* Valency.

**Hexicology.** Ecology (*q.v.*).

**Hexoses.** Sugars of composition  $C_6H_{12}O_6$ . *Ex.* glucose.

**Hibernaculum.** A "bud"

or "resting-part" of an an. (*ex.* polyzoa) or pl. that persists through winter and gives rise to a new individual during next year. Also *app.* an epiphragm. *See* Statoblast. **Hibernation.** The resting, torpid, or lethargic state of cert. an. during winter when they "feed" on reserve fats, etc.

**Hiccup.** (Hiccough.) *See* Diaphragm.

**Hidrosis.** Perspiration. Excretion of water and waste-products by skin.

**High frequency, elec.** Any frequency exceeding 15,000 cycles per sec. **High tension.** Exceeding 1000 volts; but in wireless it is *app.* voltage of h.-t. circuit = about 150 volts.

**Higher and lower organisms.** "Higher," in biology, means more complex, specialized, and differentiated, and hence better adapted for dominating environment more variously and extensively. In this sense man is the *highest* an. The term "lower" has a converse meaning.

**Hilum.** Point where ovule is attached to seed-vessel. *Syn.* omphaloidium.

**Hinny.** Hybrid, sometimes fertile, of stallion and f. ass. *Cf.* Mule.

**Histogenesis.** Tissue formation. *Opp.* histolysis. **Histology.** Study of tissues and body-fluids. **Histolysis.** Tissue dissolution. *Opp.* histogenesis. **Histotropism.** Response to some specific tissue-extract.

**Hoatzin.** *Opisthocomus cristatus* of S. America. A bird whose young can see, run, and dive, almost directly they are hatched. A claw on index

finger and thumb enables them to climb about the thickets.

**Holmium**, *ch. el.* Ho. Metal. *At. no.* 67; *at. wt.* 163.5.

**Holo**. Prefix meaning complete, whole.

**Holoblastic**. *App.* ova with little yolk and the segmentation of which is complete. *Cf.* Meroblastic.

**Hologamy**. Condition in which somatic- and germ-cells are similar. *Cf.* Macrogamety.

**Holometabolism**. Condition in insects wherein metamorphosis is complete (*ex.* butterfly—egg—grub—chrysalis—imago). *Cf.* A-, Hetero-metabola, Hemi-metabolism.

**Holomorphism**. Regeneration (*q.v.*) of a lost part in its entirety.

**Holophytic**. Feeding on unelaborated—*i.e.*, inorganic—material; typical pl. nutrition. *Cf.* Autotrophy;

**Holozoic**. **Holoptic**. Having coadapted eyes. *Cf.* Dichoptic.

**Holothurian**. A worm-like echinoderm. *Ex.* sea-cucumber.

**Holozoic**. Typical an. nutrition by ingestion of already-elaborated—organic—material. *See* Saprophytic.

*Cf.* Holophytic.

**Homeokinesis**. Second stage of meiosis in spermo- and oo-genesis when chromosomes split lengthwise. *Cf.* Heterokinesis.

**Homeotypic**. Homologous.

**Hominidæ**. Men. A fam. of Catarrhine group of the Sub-order anthropoids of the O. primates of which there is only one genus, *homo*, and one species, *H. sapiens*.

The fam. possesses three characters differentiating it from the other anthropoids: (1) erect gait with its spinal modifications; (2) articulate speech; (3) highly specialized faculty of reasoning. Minor features differentiating man from anthropoids and apes in general are: nakedness,

well-developed and deeply-convoluted brain exceeded in mass only by that of whale and elephant, and, relatively to body-wt., larger than all brains except those of a few small an. like humming-birds, tomtits, and mice. The brain also has a very large grey matter area and completely covers the cerebellum; the face is non-projecting with a facial angle of 80° as compared with 45° for other anthropoids; well-marked chin, an S-shaped lumbo-dorsal curve to spine, relatively short fore-limbs, a functional thumb, but non-opposable great toe; large buttocks, small canines, disappearing or rudimentary wisdom-teeth, vermiform appendix, laryngeal pouches (remnants of "howling apparatus"), ear-muscles, tail, and tail-muscles. *See* Classification; Tail.

**Homo**. (1) Man. (2) Prefix denoting similarity. *Opp.* hetero.

**Homoblastic**. Having direct embryonic development. *Per.* parts arising from similar cells.

**Homocercal**. *App.* symmetrical, equally-lobed fish-tail. *Cf.* Aniso-, Iso-cercal.

**Homodont**. Having all teeth alike.

**Homodrom-al**, -ous. Having genetic spiral in alternate-leaved phyllotaxy similarly directed in both stem and branch. *Cf.* Antidromal.

**Homocœsis**. Assumption by one part of likeness to another part—*e.g.*, of stamen to petal, of antenna to limb. *Syn.* metamorphy.

**Homogametes**. One-typed gametes. *Syn.* isogametes. *Cf.* Heterogamete.

**Homogametic sex**. Sex with similar sex-chromosomes.

**Homogamy**. Condition wherein gametes of similar size, etc., conjugate; having stamens and pistil mature at same time or same flower. *Syn.* isogamy; macrogamety; inbreeding.

**Homogeneous**. *App.* a medium, with chemical composition and density the same in all its parts. Resemblance in structure due

to common descent. *Cf.* Homoplastic; Isotropic. *Opp.* heterogeneous. **Homo-genesis, -geny.** Reproduction in offspring of characters similar to those in parents; correspondence in parts due to common descent. **Homogony.** Condition of having one type of flowers with stamens and pistil of uniform relative length. **Homoiotherm-al, -ic.** Warm-blooded. *Syn.* idiothermous. *Cf.* Poikilothermal. **Homologous.** *App.* structures which are morphologically similar and, consequently, which have a like embryonic origin and to cells resembling parent cells. *Syn.* Homeotypic. *Cf.* Analogy. **Homologous chromosomes.** Members of same chromosome pair. **Homologous organs.** Organs *structurally and developmentally* similar—e.g., front fins of fish, forelegs of frog, wings of bird, flippers of whale, and arms of man. *Cf.* Analogy; Heterologous. **Homologues.** Organs similar in structure and origin, e.g., air-bladder and lung. Gills and lungs are analogous. Any one of a series of ch. compounds of structure differing regularly by some radical, such as  $\text{CH}_2$ . **Homomorphism.** Having perfect flowers of one type. *Cf.* Hemimetabolism. **Homoplastic, -y.** Convergence (*q.v.*). Acquired, i.e., not inherited, correspondence between parts. *Syn.* isotelic. *Cf.* Homogeneous. **Homothermous.** *App.* animals whose temp. is independent of external temp.—e.g., birds and mammals. **Homotropous.** Having micro-pyle and chalaza at opp. ends. **Homozygosis.** Producing one

kind of gamete only relative to a given genetical factor. **Homozygote.** An organism each cell of which contains genes that bring out like characters. *See* Mendelism.

**Hormone.** Ductless gland secretion that activates cert. organs. *Syn.* endocrine; autacoid; chemical messenger. *See* Chalone.

**Horse-power.** It is = a rate of 33,000 ft.-lbs. of work per min., or 550 per sec. 1 H.P. = 745.2 watts ( $g = 980$ ); 745.7 watts ( $g = 980.665$ ).

**Hyal-ine, -oid.** Clear and glass-like. **Hyaloplasm.** The clearer and more liquid part of protoplasm.

**Hybrid.** Offspring of two individuals belonging to different races, genera, species, or varieties. **Hybridization.** Cross-breeding (*q.v.*).

**Hydathodes.** Any pl. epidermal structure that excretes water. **Hydra.** A f.-w. coelenterate; a polyp (zooid). **Hydrate.** A compound containing water in combination.

**Hydro.** Prefix denoting hydrogen or water. **Hydrocarbon.** A compound containing H and C only. **Hydrocaulis, -us.** Stalk of a hydroid colony. *Cf.* Hydrocladia. **Hydrocele.** Accumulation of serous fluid. **Hydrocephaly.** Dilatation of brain-ventricles by serous fluid. Water on the brain. **Hydrocladia.** *See* Corbula. Secondary, zooid-bearing, branches of a hydrocaulis (*q.v.*). **Hydroceal.** A water-vascular system. **Hydrocyst.** A water-cyst. A dactylozooid.

**Hydrogen, ch. el.** H. Lightest known gas. *At. no.* 1; *at. wt.* 1.00828. *See* S.L.

B.p. -252.7° C. M.p. -259.1° C. It has the simplest atom known, consisting of one proton and one planetary or valence electron. An isotope ( $H^2$ ) is called heavy hydrogen, deuterium, or diplogen. A.W. 2.01473.

**Hydroid.** Hydra-like. One of the hydrozoa. A tracheid. *See* Planoblast.

**Hydrolysis.** The splitting of a molecule with addition of H and O in proportions to form water. *Opp.* condensation (*q.v.*). Starch is converted to maltose, and maltose to glucose, by h.

**Hydrophilous.** Pollinated through agency of water.

**Hydrophyte.** *Syn.* hygrophyte (*q.v.*). **Hydrotaxis.** Response of organisms to water. *Syn.* hydrotropism (*q.v.*).

**Hydro-tropism.** Response, by curvature in pl., or by change of place in an., to stimulus of moisture—*e.g.*, roots, are positively hydrotropic. *Syn.* hydrotaxis; hygro-taxis, -tropism. **Hydrozoa.** Cl. of coelenterates including hydroids and jelly-fish.

**Hydrophilous.** Inhabiting marshy places. **Hygrophyte.** A pl. that thrives in moist ground. *Syn.* hydrophyte.

**Hydroplasm.** The more liquid part of protoplasm. *Cf.* Stereoplasm.

**Hygro-taxis, -tropism.** *Syn.* hydrotropism (*q.v.*).

**Hylophagous.** Wood-eating. **Hylophyte.** A wood pl.

**Hylozoism.** The doctrine that "life" or its attributes, in some degree, pervades all matter.

**Hymenoptera.** An O. of insects with two pairs of membranous wings. *Ex.* bee.

**Hypanthium.** Enlargement of floral torus.

**Hypaxial.** Ventral (*q.v.*).

**Hyperæmia.** Blood congestion. **Hyperæsthesia.** Exalted sensitivity. **Hyperpituitarism.** Excessive size of body due to over-action of pituitary gland. *Syn.* hyperhypophysis.

**Hyperplasia.** Excessive development. **Hyperpnoea.** Rapid breathing due to insufficient O to lungs.

**Hyperpyrexia.** High body-temp. **Hypertely.** Mimicry that has passed beyond the point of closest resemblance.

**Hyperthely.** Excess No. of nipples. **Hypertonic.** *Per.* solution in which osmotic p. has been raised by addition of salts. Solution with osmotic p. above that of serum. Increased tone or blood-pressure.

*Opp.* hypotonic. **Hypertrophy.** Excessive development. *Opp.* atrophy.

**Hypha.** A filament of mycelium of fungus.

**Hypesthesia.** Diminished sensibility. **Hypnody.** Dormant or resting stage.

**Hypnogenic.** Sleep-inducing. **Hypnosporangium.** A sporangium containing resting-spores.

**Hypnospore.** A dormant sperm, spore, or zygote.

**Hypobasal.** *Cf.* Epibasal. *Per.* lower segment of ovule or to the basal cell of germinating oospore.

**Hypoblast.** Innermost layer of blastoderm and gastrula. *Syn.* endoderm, -blast (*q.v.*).

*See* Embryogenic pole. **Hypobranchial groove.** A ciliated food-conveying channel below gills. From it the thyroid gland evolved. *Syn.* endostyle; hypopharyngeal groove.

**Hypocotyl.** Radicle. Stem below cotyledon leaves. **Hypoderm, -a.** Tissue just beneath epidermis of pl. *Syn.* Hypo-

**dermis.** Part of epidermis of insects which secretes the overlying cuticle. *Syn.* hypoderm.

**Hypogenesis.** Development without alternation of generations. **Hypogynous.** Inserted on axis below, and free of, gynæcium.

**Hypo-hypophysis.** *Syn.* hypopituitarism (*q.v.*). **Hypophare.** *See* Spongophare.

**Hypopharyngeal groove.** Hypobranchial groove (*q.v.*). **Hypophysis.** Pituitary gland. Olfactory pit of lancelet. Cell from which root-tip arises. *See* Infundibulum.

**Hypopituitarism.** Deficient development of pituitary gland. **Infantilism.** Hypo-hypophysis.

**Hypopyge.** Clasper (*q.v.*). **Hypostasis.** Condition of being controlled or suppressed. *Cf.* Epistasis.

**Hypotenuse.** Side of a right-angled triangle opposite the right angle. **Hypothesis.** A natural explanation of a phenomenon warranted by consideration of the facts observed. A provisional ex-

planation which, if partly confirmed, becomes *theory* (*q.v.*) and, if fully confirmed, becomes *law* or *fact*. **Hypotonic.** *App.* solution the osmotic p. of which is low because of paucity of salts, or a solution the osmotic p. of which is below that of serum. Decreased tone or blood p. *Opp.* hypertonic. **Hypoxanthin.** Crystalline nitrogenous substance in muscle, sperm, and seeds.

**Hypselo-, hypso-dont.** *App.* teeth with high crowns and short roots. *Ex.* molars of horse. *Cf.* Brachyodont.

**Hysteresis.** A lagging or retardation of effect after the forces acting are changed or withdrawn. A phenomenon of loss of energy—as though from internal viscosity or friction—in the cycle of magnetization and demagnetization. *See* Fatigue; Irritability.

**Hysterogenic.** *Per.* later growth or development, or later stages of crystallization.

## I

**Ice.**  $H_2O$ . Solid crystalline (hexagonal system) form of water of *sp. gr.* 0.9166—water at 4° C. being 1.0. *Cf.* Hail; Snow; Water.

**Ichneumonidæ.** *Fam.* of Hymenoptera that lay their eggs inside the bodies or eggs of other insects.

**Ichthyic.** *Per.* or resembling a fish. *Syn.* ichthyoid. **Ichthyoda.** Fishes. **Ichthyoid.** *Syn.* ichthyic (*q.v.*). **Ichthyology.** Study of fishes. **Ichthyopterygium.** The commoner type of fish's tail in which the radials arise from a

no. of basal pieces. **Ichthyornis.** Cretaceous bird that had teeth and biconcave reptilian vertebrae. **Ichthyosauria.** Marine fish-shaped reptiles with limbs transformed into paddles.

**Ideation.** *Thinking.* Thought. **Imagination.** A product of perception (*q.v.*). Seeing, feeling, and tasting an apple furnish the *percept*, "apple." Subsequent memory of the apple, or the sight of the word "apple," provides the *idea* of the fruit.

**Idiochromatin.** Temporarily

quiescent (generative) chromatin. *Cf.* Trophochromatin. **Idiochromidia.** *Syn.* Sporetia (*q.v.*). Generative chromidia. *Cf.* Trophochromidia. **Idiochromosome.** An additional chromosome (*q.v.*) having a relation to sex observed in cert. germ-cells. **Idioplasm.** Hereditary substance in living matter. *Syn.* chromatin; germ-plasm; chromatoplasm. **Idiosome.** Smallest particle of living matter. A fundamental protoplasmic unit. The separate portion of archoplasm which becomes the head-cap of a spermatozoon. The cell-body of an auxocyte containing the centrioles. *Syn.* centrotheca; biophor. **Idio-thermic, -thermous, zoo.** Warm-blooded. *Syn.* homoiothermal.

**Igneous rocks.** The oldest, primal, prearcheozoic, unstratified, unfossiliferous rocks, the minerals comprising which bear signs of having been molten through intense heat.

**Iguanodonts.** Early cretaceous bird-footed reptiles. *Ez.* dinosaur.

**Ileum.** Lower part of intestine between duodenum above and caecum below.

**Iliac.** *Per.* ilium, the flank. A plate-like bone of the pelvic arch (hips) that supports abdominal contents.

**Illinium, ch. el.** II. A "rare earth." *At. no.* 61; *at. wt.* 146 (?).

**Illusion.** False interpretation of a sensation. *Cf.* Delusion; Hallucination. *See* Perception.

**Imaginal, zoo.** *Per.* imago. **Imaginal discs.** Patches of cells of larval hypoderm that, becoming partially detached

from integument, give rise to new organs. *Syn.* histoblasts.

**Imagination, psy.** The process of making mental pictures or *images* not present to, and, therefore, without present help of, the senses. *Sensations* provide the *percepts* from which *images* arise and give origin to *concepts*.

**Imago.** The last, perfect, adult stage in insect-metamorphosis. *Ez.* butterfly. *See* Pseudimago.

**Imbricate, bio.** *App.* scales, plates, bracts, etc., that overlies one another like tiles on a roof.

**Immunity.** Capacity to resist infection by micro-organisms. Invulnerability to bacterial toxins.

**Impedance.** Resistance to an alternating current in regard to circuit-capacity, self-inductance, ohm resistance, separately or combined.

**Impenetrability.** A quality of matter in virtue of which it takes up space to the exclusion of other matter, on the principle that two bodies cannot occupy the same space at the same time.

The facts that all bodies are compressible in some degree, and that an ounce of water mixed with an ounce of alcohol forms a solution that occupies less than two ounces, indicate that it is probably only the fundamentals (electrons, etc.) of matter that are really impenetrable.

**Impregnation, bio.** The entry of a spermatozoon from a m. into an ovum within a f. *Syn.* spermatization.

**Impulse, psy.** Action without deliberation upon the presentation of a percept (*q.v.*) or idea (*q.v.*). *Physiology.* Change of state produced in and passing

along a nerve during conduction.

It is probably a "wave of depolarization" taking place in three layers of a "membrane" or "film" surrounding the nerve, during which process the neutral middle layer is broken down so that positive and negative ions in the two outer layers meet. The speed of the nerve impulse in mammals is about 300 ft. per sec.

**Incisor, bio.** Adapted for cutting. Any bony ridge. Pre-maxillary teeth of mammals. Any one of the four upper, or four lower, front teeth of man.

**Inco-ordination.** Irregularity of movement due to defective muscle control.

**Incubation.** (1) Hatching of eggs by heat. (2) Period between infection by micro-organisms and appearance of the symptoms produced by their toxins. **Incubous.** *App.* serially disposed leaves in which the base of each is covered by upper part of next lower one. *Cf.* Succubous.

**Incumbent.** (1) Bent downwards so as to touch another structure. (2) Superimposed. (3) Opposed to—*e.g.*, a cotyledon folded so that hypocotyl touches its back. *Cf.* Accumbent.

**Incus.** The "anvil" ossicle of mammalian middle ear; it is represented by the "quadrate" (*q.v.*) in lower vertebrates. An anvil-like structure in gizzard of rotifers.

**Indeciduate.** Non-caducous; not falling off. *App.* an. in which the maternal part of the placenta is not shed with the birth of the offspring. **Indeciduous.** Not falling off. *App.* pl. that do not shed their leaves when latter attain ma-

turity. *Syn.* persistent; everlasting; evergreen.

**Indehiscence.** *App.* pl. the seeds of which remain within the fruit, the dry pericarp of which bursts and scatters the seeds only when germination occurs. *Cf.* Dehiscence.

**Indeterminate variations.** Variations in every direction and arising under no known law. The variations upon which the Darwinian factor of Natural Selection operates. *Cf.* Determinate v.

**Index, cephalic.** The max. breadth of the head divided by the max. length and multiplied by 100. A cranium with C.I. 75 and below is *dolichocephalic* (long headed); of 83.1 and above, *brachycephalic* (short-headed); of 75.1-77.6, sub-dolichocephalic; of 80.1 to 83, sub-brachycephalic. Medium heads are *mesaticephalic* and have a C.I. of 77.7-80. *See also under* Cephalic.

**Index notation.** Exponential n. A system of representing very large nos. Thus, unity followed by 50 zeros is written  $10^{50}$  and its reciprocal fraction  $10^{-50}$ .  $2.57 \times 10^3$  is 2570;  $5.5 \times 10^{-3} = 5.5$  or  $\frac{11}{2,000}$ .  $10^3 \times 10^7 = 10^{10}$ .  $10^{-4} \times 10^{-6} = 10^{-10}$ . A tenth is  $10^{-1}$ ; a hundredth,  $10^{-2}$ ; a thousandth,  $10^{-3}$ ; a millionth,  $10^{-6}$ ; one millionth of a million or (Eng.) billionth,  $10^{-12}$ ; a millionth of a billion (Eng.), or one trillionth,  $10^{-18}$ . I., morphological. A ratio expressing the proportional dimensions of limbs to trunk.

**Indigenous.** Naturally belonging to—*i.e.*, not imported into—a district.



**Indium**, *ch. el.* In. Metal. *At. no.* 49; *at. wt.* 114.76.

**Individual**, *bio.* A single unit. A "person." A zooid of distinctive function in a hydrozoan colony. *Syn.* isophytoid; polypide. *See* Classification. **Individualism**. Struggle for self-existence. Egoism. Symbiosis in which the two parties together form an apparently single organism. **Individuality**. The slight differences that cause no two organisms to be quite alike. **Individuation**, *zoo.* The development of interdependent functional units in colony formation.

**Induced current**. Electric current aroused in one circuit by a current in another one.

**Inductance**. Electrification of one conductor by another conductor that is electrically charged or carrying a current. **Induction**. Coefficient of self-inductance. **Induction**, *Syn.* (1) inductance (*q.v.*). (2) *Psy.*

Reasoning from the part to the whole, from the particular to the general. Induction is synthetic, deduction (*q.v.*) analytic. In induction a conclusion is probable only. **Induction**, **electromagnetic**. The E.M.F. (*q.v.*) and current set up in a conductor when it is moved in a magnetic field at right angles to the lines of force, or when, *v.v.*, a field is moved about a conductor.

**Induplicate**, *App.* bud-leaves that are bent or rolled without overlapping during veneration; also to bud sepals or petals that are folded inwards at points of contact in aestivation.

**Indusium**. (1) The case of

insect larvæ. (2) A membranous outgrowth of pl. epiderm to protect a sorus (*q.v.*)—an episporangium. (3) Part of olfactory lobe of brain.

**Induviae**. Scale-leaves. Leaves that, after withering, remain attached to pl. **Induviate**. *Per.* induviae (*q.v.*).

**Inertia**. Property of matter (*q.v.*) by which it offers resistance to a change in its state of rest or in its state or direction of motion. *See* Mass.

**Inflorescence**. Flowering; blossoming. Arrangement of flowers on the axis of a pl. *Syn.* capitulum. The peduncle, pedicels, and flowers of a pl. *Ex.* daisy. *See* Floret, Cymose, Racemose, Monopodial.

**Infra-red rays**. Rays emanating from hot bodies that have lower frequencies than those that evoke vision. *i.r.* rays have a w.-l. 8000.0 to 4,000,000 A.U. (*q.v.*), and frequency  $4 \times 10^{15}$  to  $7 \times 10^{11}$ . *See* Ultra-Violet; Wave.

**Infructescence**. Fruit (*q.v.*).

**Infundibulum**. Any funnel-shaped structure. The siphon of cephalopods. The downward-projecting evagination of neural floor of fore-brain which meets an upward-projecting evagination from the mouth roof, the two contributing to form the hypophysis or pituitary body (*q.v.*).

**Infusoria**. A *cl.* of ciliated protozoa that grow readily in organic infusions.

**Ingluvies**. Crop (*q.v.*).

**Inguinal**. *Per.* groin.

**Inheritance**, *bio.* Heredity. Autochthony. The reception by offspring of characters (*q.v.*)—physical and psychic—from parents. *See* Gene.

**Inhibition.** Restraining. Checking. Prohibiting. *Zoo.* *App.* nerves which check or control action. *Psy.* Opposition to cert. "complexes" striving for recognition. *Cf.* Sublimation.

**Ink sac.** A glandular receptacle in mantle-cavity of cephalopods (squid). It contains a black fluid, sepia, which is ejected as a "cloud" when the creature is pursued.

**Innate.** (1) *Zoo.* Congenital. *Inborn.* *Opp.* acquired. (2) *Bot.* Basifixed, as when anther filament is attached only at base.

**Innervation.** Nerve supply and distribution.

**Inorganic.** Not derived from living organisms.

**Inquiline.** A commensal (*q.v.*). An an. that lives in the home and shares the food of another an. *Ex.* guest flies that lay their eggs in the galls made by gall-flies. Cuckoo parasites. Social parasites.

**Insects.** *Cl.* of arthropods. Six-legged invertebrates with bodies clearly divided into head, thorax, and abdomen, with an exoskeleton, a dorsal brain and ventral chain of ganglia, and for the most part undergoing metamorphosis from egg through larva to pupa and imago. The majority live on land and in air, a few in fresh water, and a very few in the sea. Of the total living matter constituting all the an. on the earth, insects probably contribute well over a half. There are 500,000 species (*q.v.*). *Syn.* hexapoda.

**Insectivora.** An O. of insect-eating mammals, mostly nocturnal.

**Insessorial, zoo.** Adapted for perching.

**Insolation.** Exposure to sun's rays.

**Instar.** Any one of the stages in insect metamorphosis. A pupa.

**Instinct.** A complex and almost unvarying mode of behaviour which may, however, be slightly modified by learning. An "action-pattern" present from birth. There is no essential difference between an instinct and a reflex (*q.v.*), but the former concerns the an. as a whole and may be directed to a distant goal, the latter concerns a part of the an. and is directed to some immediate end. Instinct demands an intact an.; a severed limb will exhibit a reflex. *Cf.* Habit; Intelligence. *See* Irritability.

**Insulation.** Prevention of leakage of an elec. charge or current. **Insulator.** A material offering resistance to flow of electrons, heat, sound, etc.

**Integration, bio.** The process by which individuals of a lower order become united to form individuals of a higher order. A type of differentiation (*q.v.*). The consolidation and harmonizing of parts.

**Intelligence.** Capacity for knowledge and understanding, especially for the suitable handling of novel situations. *Cf.* Instinct. *See* Brain. I. quotient. Mental age divided by chronological age.

**Intensity, phy.** In acoustics this is the loudness of a note, and depends upon the amplitude—i.e., the distance through which the separate mols. of air oscillate. Unit electric field intensity is the field which exerts a force of one dyne on unit positive charge. Lumin-

ous intensity is candle power (*q.v.*).

**Interference, *elec.* *App.*** anything (*see* Strays; Fading) that prevents the proper reception of wireless waves—thunderstorms, sunspots, electric plants, other transmitters, etc. In essence it is the blank produced through the annihilation of two equal-sized waves when the crest of one coincides with the trough of the other. **Internode, *bio.*** Part of nerve or of stem between two adjacent nodes. A merithallus.

**Interoceptive field.** The internal surface of an an. such as the lining of its alimentary canal, wherein lie the interoceptors (*q.v.*). *Cf.* Exteroceptor. **Interoceptor.** A receptor that receives stimuli from the interoreceptive field. *See* Proprioceptor. **Interstitial cells. *App.*** cells of the testis that lie between the genitaloid cells; also to cells of ovary that arise from the germinal epithelium in common with the primordial ova. The i.c.s are *glandular*, and their secretions (hormones) influence growth, and especially that of the sexual organs.

**Intestine.** The alimentary canal from stomach to anus.

**Intra-atomic, -cellular, -molecular, -nuclear, -uterine, etc.** *Per.* processes within, or contents of, the atom, cell, mol., nucleus, uterus, etc.

**Introrse. *App.*** anther in which pollen openings (*q.v.*) face the pistil. *Cf.* Extrorse.

**Intussusception, *bio.*** (1) Growth (*q.v.*) by deposition of new particles among and between those already in position. *Cf.* Accretion; Apposition.

(2) The slipping of one part of the bowel into an adjacent part.

**Invagination. Involution. Introversion. Insinking. Infolding.** The insinking of one part of a hollow body into the other part so that what was outside comes to lie internally—*e.g.*, in gastrulation.

**Invertase.** A carbohydrase (*see* S.L.) of pancreas and yeast which converts sucrose into dextrose (50%) and levulose (50%). *Syn.* invertin.

**Invertebrates.** An. characterized by absence of backbone.

**Invertin. *Syn.* invertase (*q.v.*).**

**Involucel.** Bracts at base of partial (secondary) umbel or around flowers of flower-head. A partial involucre. (1) Bracts around base of compound umbel or flower-head of compositae. (2) Cells around archegonia in bryophytes. **Involuntary muscle.** Plain, unstriped muscle not under control of will. **I. nervous system.** The vegetative autonomic nervous system mostly concerned in nutrition. **Involution.** (1) Insinking or turning inwards. **Invagination (*q.v.*).** (2) Impairment of structure through adverse environmental conditions. Especially *app.* cert. types of bacteria.

**Iodine, *ch. el.* I.** Non-metal. A halogen. *At. no.* 53; *at. wt.* 126.92.

**Ion.** An electrically-charged atom, mol., atomic or molecular system whereby there is produced an inequality in the no. of protons and electrons within the atom, mol., or system. When given off from metals

ions are as a rule +; when given off from non-metals —. In a + ion, or *kation*, there are less than the normal no. of planetary electrons; in a — ion, or *anion*, the planetary electrons are in excess. **Ionization.** The addition to (negative i.), or subtraction from (positive i.), a normal atom, mol., atomic or molecular system, of planetary electrons. Electrolytic dissociation. *See* Atom. I. potential. The energy required to ionize an atom or a mol. **Ionium.** Io. Radio-active, *ch. el.* of uranium (*q.v.*) series. *At. no.* 90; *at. wt.* 230.2. **Ionsphere.** Ionized layers of atmosphere between the overlying Appleton layer (*q.v.*) and underlying Kennelly-Heaviside layer (*q.v.*). *See* Fading; Strays.

**Iridium**, *ch. el.* Ir. Metal. *At. no.* 77; *at. wt.* 193.100.

**Irido-cytes, -cysts.** Modified cells—*e.g.*, those in squid—that cause iridescence (S.L.) or the play of colours due to diffraction and interference. The guanin plates within a fish's skin which give it its shiny, reflective properties. *See* Argenteum. *Syn.* leuco-, ochro-, guano-phores.

**Iris.** The thin contractile curtain between the cornea and lens of the eye.

**Iron**, *ch. el.* Fe. Metal. *At. no.* 26; *at. wt.* 55.840.

**Irradiation.** (1) Exposure to light, ultra-violet, and other radiations. (2) Spread of a nervous excitation in one part of the nervous system to other, and perhaps remote, parts. *Cf.* Concentration.

**Irreversible action.** Chemical action in which a mol., once united with another mol., will

not separate, as when a *gel* cannot be turned back to a *sol* or *v.v.*, or when hæmoglobin, once united with carbon monoxide, refuses to part from it. *Cf.* Reversible a.

**Irritability.** **Excitability.**

Capacity to enter into action (respond) on the application of a stimulus. It is characteristic of living matter, though not entirely absent in the inorganic world. *See* Fatigue. Through integrative evolution i. gives rise to *tropisms*, *reflex action*, *instinct*, and *intelligence* (*q.v.*).

**Isobars.** Lines connecting places having the same barometric pressure (corrected for altitude) at a given time.

**Isobares.** Atoms of different elements with same *at. wt.* **Isocercal.** Having symmetrical tail with spinal column extending along its median axis. *Opp.* anisocercal. **Isochronous, phy.** Having the same frequency.

**Isogametes.** *Syn.* homogametes. Undifferentiated gametes. *Cf.* Heterogametes. **Isogamy.** *Syn.* homogamy; syngamy (*q.v.*) when the pairing cells are of equal size. Union of isogametes. *Cf.* Anisogamy.

**Isomere.** A homologous part. **Isomery.** Having equal nos. of different parts. *Bot. App.* flowers with same no. of parts per whorl. **Isomorphic.** *Per.* isomorphism. Having similar shape and appearance. *App.* individuals of different races or species that are superficially alike. **Isomorphous.** *Syn.* isomorphic (*q.v.*).

**Isopoda.** An O. of sessile-eyed crustaceans with equal and similar legs. *Cf.* Amphipods. **Isosmotic.** Possessing equal osmotic pres-

sure. **Isospores.** Spores that are equal in size and, apparently, parthenogenetic. *Cf.* Anisospores. **Isotherms.** Lines connecting places having an equal temp. at a given time. **Isotonic.** Having equal tone, tension, osmotic pressure, or percentage of salts in a solution. **Isotopes.** Atoms with the same ch. properties (*i.e.*, same *at. no.*) but different

masses (*i.e.*, different *at. wt.*). The *nuclei* of isotopes are of different structure. There are (*e.g.*) two kinds of silver, one with mass 107, another with mass 109, the *mean at. wt.* being 107.880. **Iso-trope, -tropic, bio.** *App.* eggs that have no predetermined axes. Having the same properties or qualities in all directions. *Cf.* Anisotropic.

## J

**Jacobson's organ, zoo.** A nervous structure consisting of an isolated area of the olfactory membrane. It is well developed in amphibia, reptiles, monotremes, and herbivorous an., but is vestigial in man, in whom it is at its best in the 5-months foetus. In an. wherein it functions it is acted upon by odours from the mouth and is probably a smell-taste "sampling" organ.

**Jaculator, bot.** A placental process, usually hooked, of fruits.

**Jaculiferous, bio.** Having dart-like processes.

**Jar, elec.** Unit of electrostatic capacity; the 1/900 of a micro-farad.

**Jaw, Syn. genys.** (1) A tooth-bearing cartilaginous or bony structure forming part of vert. mouth. (2) A horny toothless structure of invertebrate mouth. **J-foot.** Maxillipede of arthropods.

**Jecorin.** A phosphoric substance in many organs of the body.

**Jejunum.** The intestine between duodenum and ileum.

**Jelly-fish.** *Syn.* medusa;

discophora. One of the hydrozoa.

**Johnston's organ.** A nervous structure, probably subserving perception of vibrations, near base of antennae in diptera.

**Joint, Syn.** arthron; articulation; geniculation. (1) Junction of two bones. (2) In inverts. it is a "segment" or piece between two adjacent "joints." In a *hinge-joint*, movement is in one plane only; a *pivot-joint* or *trochoid joint* permits of rotary movement.

**Jordan's organ.** *Syn.* chaetosema. *Zoo.* A sense-organ of uncertain function on head of cert. Lepidoptera.

**Joule, elec.** Unit of work. Energy expended in 1 sec. by 1 ampere at E.M.F. of 1 volt through 1 ohm resistance. A j. is equal to 10,000,000 ergs, or 1 watt-sec. or 0.738 ft.-lb., or 0.24 small calorie. **J.'s Law.** The heat generated in a circuit is proportional to the sq. of the current and is equal to the product of the sq. of the current into the resistance and the time of flow.

**Jubate.** *Maned.* Having a mane-like growth.

**Jugate.** Possessing a jugum (*q.v.*).

**Jugular.** *Per.* neck; throat; clavicle; jugular vessels; ventral fins of fish ant. to pectoral fins; and to jugulum. (*q.v.*).

**Jugulum.** (1) The clavicle or collar-bone. (2) Fore-part of breast in birds; the fore-neck. (3) The wing-junction of insects.

**Jugum, bot.** (1) A pair of opposite leaflets. (2) Ridge on mericarp of umbelliferæ. *Zoo.* (3) Fore-wing lobe replacing frenulum in cert. moths. (4) Wing-junction of lesser sphenoid bone.

**Jurassic, geo.** *Sub-div.* of mesozoic era, following triassic, and preceding cretaceous. The rocks characterize the Jura Mts.

## K

**Kakogenic.** Dysgenic (*q.v.*).

**Kalidium, bot.** A kind of sporocarp.

**Kalymmocytes, zoo.** Cells in test of ascidians which migrate into ovum after maturation. *Syn.* egg-follicle cells. Test cells.

**Kamptoderm.** Tentacle-sheath of polyzoa.

**Karyaster.\*** A stellate collection of chromosomes. *Cf.* Aster; Cytaster. **Karyenchyma.** *Syn.* karyolymph (*q.v.*). **Karychylema.** *Syn.* karyolymph (*q.v.*). **Karyogamy.** Fusion of, and interchange of material in, nuclei during cell-conjugation. **Karyokinesis.** Indirect cell div. *Syn.* cytodiæresis; mitosis; karyomitosis. Complex div. of cell and nucleus. *Opp.* amitosis. It includes four stages: the pro-, meta-, ana-, and telophase, the end-purport of which is the equable distribution of hereditary elements (genes and chromosomes) in the daughter-cells. **Karyolymph.** Fluid part of nuclei.

\* See also under "C" for words beginning with an optional "C" or "K."

*Syn.* karyochylema; karyenchyma; nucleenchyma. Nuclear sap. **Karyolysis.** Solution of nucleus. **Karyomere.** *Syn.* karyomerite. A vesicle into which a chromosome is converted during karyokinesis. **Karyomerite.** *Syn.* karyomere (*q.v.*). **Karyomicrosome.** A nuclear granule. **Karyomite.** A chromosome. **Karyomitome.** Nuclear network. **Karyomitosis.** *Syn.* karyokinesis (*q.v.*). **Karyon.** A nucleus. **Karyophans.** *Syn.* microsomes. Nucleus-like bodies in spiro-neme and axoneme of stalk of infusoria. **Karyoplasm.** *Syn.* nucleoplasm. Nuclear protoplasm. **Karyorhexis.** Fragmentation of nucleus. **Karyosome.** (1) Aggregation of chromatin in resting nucleus. (2) Chromosome. (3) Nucleus. (4) Nucleolus. *Syn.* endosome. *Cf.* Plasmosome. **Karyosphere.** Large nucleolus originating chromosomes. **Karyota.** Nucleated cells. **Karyotheca.** Nuclear membrane. **Karyotin.** Nuclear material.

**Katabolism.** Disassimilation. Destructive metabolism

(*q.v.*). Analytic, breaking-down, disruptive, energy-expending ch. processes of living matter resulting in production of simpler ch. compounds and waste products. *Opp.* anabolism (*q.v.*). **Katagenesis**. Retrogressive evolution. **Katakinetic, bio.** *App.* processes involving energy-expenditure. *Opp.* anakinetic. **Katakinetometers.** Unreactive, stable atoms and mols. **Kataphase.** Stage of mitosis from formation of chromosomes to div. of cell. *Cf.* Anaphase. **Kataphoric.** *App.* passive states. **Kataplexy, zoo.** Mimicking death. **Katastates, bio.** Waste products. *Cf.* Anastates.

**Katelectrotonus.** Increased excitability of a nerve in neighborhood of neg. pole after passage of a non-polarizing elec. current. *See* Electrotonus. **Kathode.** The neg. electrode. The neg. terminal of a battery, cell, or valve. It is the electrode that has a deficit of protons and surplus of electrons, and from which the migration of electrons—*i.e.*, the elec. current—starts. *Opp.* anode (*q.v.*). **K. particles.** Low-vel. electrons. **K. ray.** A "stream" of cathode particles. **Kathodic.** (1) *Per.* cathode. (2) *Bot. App.* leaves that do not arise conformably to a genetic spiral. **Kation.** A neutral atom that has lost an electron and which in consequence has a positive charge. The pos. ion which migrates to cathode. *Cf.* Anion.

**Keel.** (1) *Zoo.* "Breast-bone" of flying birds. (2) *Bot.* Boat-shaped structure formed by two anterior petals in *leguminosae*.

**Kennelly-Heaviside layer.** A zone of ionized atoms [part of the ionosphere (*q.v.*)] in atmosphere about 65 miles above earth. It is transparent to short wireless waves but reflects back long wireless waves. *See* Appleton.

**Kepler's laws.** (1) Planets revolve around sun in elliptical orbits having sun in one of the two foci. (2) Radius-vector of each planet sweeps over equal areas in equal times. (3) The squares of the periodic times of the planets are proportional to the cubes of their mean distance from the sun.

**Keratin.** A horny, insoluble, sulphur-containing protein of outer skin, scales, feathers, horns, nails, and claws. **Keratinization.** Becoming horny. **Keratogenous.** Producing horny material. **Keratohyalin.** Clear, horny substance in skin. **Keratoid.** Corneous, horn-like. **Keratose.** Having horny fibres.

**Kernel.** Inner part of seed containing the embryo.

**Kidney.** Paired abdominal organ that excretes waste products. Developmentally it consists of three parts, the *pro-*, *meso-*, and *meta-nephros*. *Syn.* rein; nephridium; green-gland.

**Kilo-calorie.** *See* Calorie. **Kilocycle, elec.** 1000 cycles. **Kilogramme.** Mass of 1000 c.c.s of water at 4° C. It is equal to 1000 grammes; or 980,616 dynes; or 2.2046 lbs. **Kiloherz, elec.** 1000 cycles per sec. **Kilolitre.** A cubic metre. **Kilometre.** 0.62137 mile or 39,370.113 in. or 10<sup>3</sup> met. 10<sup>5</sup> cm. 10<sup>6</sup> mm. 10<sup>9</sup> microns or 10<sup>12</sup> millimicrons.

(A cub. kilometre = 0.2376 cub. mile or  $10^{15}$  c.c. A sq. kilometre = 0.3861 sq. mile or 247.11 acres or  $10^6$  sq. metres.)

**Kilovolt-ampere, elec.** 1000 volt-amperes. **Kilowatt, elec.** Unit of elec. power; 1000 watts. **Kilowatt-hour.** The B.O.T. unit of elec. power, or 1 kilowatt expended for 1 hour.

**Kinaesthesia.** Muscle sense. Sense of effort. **Kinaesthetic.** *Per.* kinaesthesia. *Syn.* motorial.

**Kinase.** A substance which transforms zymogen into enzyme. *Syn.* zymoexcitator.

**Kinesodic, zoe.** Conveying motor impulses.

**Kinetic energy.** Power of doing work possessed by a body in virtue of its motion. *See* Energy. **Kinetoblast.** Outer ciliated (motile) coat of aquatic larvæ. **Kinetogenesis.** Neo-

Lamarckian theory that an. adaptations are produced by movements. **Kinetomeres.**

Mols. and atoms. They include ana- and kata-kinetomeres (*q.v.*). **Kinetonucleus.** *Syn.* kinetoplast (*q.v.*). **Kinetoplasm.** An energy-producing iron-containing nucleo-protein. *Syn.* achromatoplasm. **Kinetoplast.** (1) Secondary nucleus in trypanosomes. (2) A structure resulting from union of para-basal body and blepharoblast in mastigophora. *Syn.* Kinetonucleus. **Kinetosome.** A granular body that appears in polar-plate region during sporogenesis.

**Kinoplasm.** *Syn.* archi-, ergasto-, morpho-plasm (*q.v.*).

**Krause's corpuscles.** Sense-organs of touch.

**Krypton, ch. el.** Kr. An inert gas. *At. no.* 36; *at. wt.* 83.7.

## L

**Labellum.** Any small lip-like structure such as the lip of a perianth or corolla. A mesopetalium. A fleshy body beneath labrum (*q.v.*).

**Labidophorous.** Having pin-cer-like organs.

**Labile.** Plastic. Adaptable. The shifting interchange of colloids.

**Labrum.** A lip—*e.g.*, of gastropod shell or in front of insect mouth.

**Labyrinth.** The part of internal ear that contains the cochlea and semi-circular canals and forms an organ of hearing (*q.v.*) and orientation. In sharks it is an organ of balance only. The "lateral line" (*q.v.*)

of fishes is probably the fore-runner of the l. the auditory part (cochlea) of which evolved when verts. left the water. *See* Membranous. **Labyrinthodonts.** Extinct amphibians (stegocephalia) with complex teeth.

**Lac.** Resinous secretion of cert. insects. **Laccase.** An enzyme of plants.

**Lacertiform.** Lizard-like.

**Lachrymal gland.** The tear gland.

**Lacinate.** Incised; ringed.

**Lactalbumin.** An albumin of milk. **Lactase.** Intestinal enzyme. **Lactiferous.** Milk-bearing. *Syn.* galactophorous. **Lactochrome.** A colouring



matter of milk. **Lactose.**  
*Syn.* galactose. Milk-sugar.  
 $C_{12}H_{22}O_{11}$ . **Lactosis.** *Syn.*  
 galactosis (*q.v.*).

**Lacunosorugose.** Deeply  
 furrowed or pitted. **Lacus-**  
**trine.** *Per.* or inhabiting a lake  
 or its shores.

**Læotrop-ic, -ous.** Inclined,  
 twisted, or coiled to the left.  
*Syn.* leiotropic.

**Lævulose.** A lævo-rotary  
 sugar of honey and fruits.  
 $C_6H_{12}O_6$ . The sweetest sugar  
 known.

**Lagena.** An outgrowth of  
 the sacculus; terminal part of  
 cochlea (*q.v.*). **Lageniform.**  
 Flask-shaped.

**Lagopodous.** Having hairy  
 or feathery feet.

**Lamarckism.** Theory that  
 "acquired" characters are  
 transmissible.

**Lamella.** Any thin, plate-  
 like structure. A gill or scale.  
*Syn.* lamina (*q.v.*). **Lamelli-**  
**branchiata.** Bilaterally sym-  
 metrical bivalves. *Ex.* cockle;  
 mussel. **Lamelliferous.** Hav-  
 ing scales or plates.

**Lamina.** A lamella (*q.v.*).  
 Blade of a leaf. **Laminarian**  
**zone.** The sea floor and zone  
 to a depth of 90 ft. *Cf.* Abyssal;  
 Coralline; Littoral. **Lam-**  
**ination, geo.** Arrangement  
 of rocks *parallel* to bedding—  
*e.g.*, shale. *Cf.* Cleavage.

**Lanate.** Woolly; hairy.

**Lanceolate.** Lancet-shaped.

**Lanthanin.** *Syn.* oxychrom-  
 atin; linn (*q.v.*). **Lanthanum,**  
*ch. el.* La. Metal. *At. no.* 57;  
*at. wt.* 138.92.

**Lanugo.** Downy hair cover-  
 ing the 5-8 months human  
 fœtus. It is shed before birth.

**Lapidicolous.** Living under  
 stones.

**Lappaceous.** Prickly.

**Larva.** The immature but  
 active and often independent  
 stage of cert. animals markedly  
 different from adult stage.

*Ex.* actinotrocha; axolotl; cater-  
 pillar; dipleurula (*q.v.*); erichthus;  
 glaucothoe; glochidium; lepto-  
 cephalus (*q.v.*); maggot; megalopa;  
 nauplius; parenchymula; phoro-  
 zoon (*q.v.*); pilidium; planidium; planula;  
 pluteus (*q.v.*); protaspis; pro-  
 scolex; protozoöea; redia; sterrula;  
 tornaria; triungulus; trochosphere;  
 veliger (*q.v.*); warble; wire-worm;  
 zœa; zoanthella.

**Larvacea.** Chordates (*q.v.*).  
 Appendicularians. **Larviparous.**  
 Giving birth to live larvæ.  
**Larvivorous.** Feeding on  
 larvæ.

**Larynx.** Organ of voice be-  
 tween trachea and base of  
 tongue. *Cf.* syrinx.

**Lata type.** A mutant with  
 more chromosomes than its  
 parent.

**Latebricole.** Inhabiting  
 holes.

**Latent heat.** Heat expended  
 in doing work by changing the  
 state of a body without raising  
 its temp. L.h. is the equiva-  
 lent of work done in lessening  
 the force of cohesion by "melt-  
 ing" a solid to a liquid or by  
 converting a liquid to a vapour.  
*See* Heat; Vaporization.

**Lateral line.** A series of  
 sense-organs in fishes and  
 amphibia lying along each side  
 of the body. The "ear" of  
 man originated as a specialized  
 zone of the fish's l.l. In the  
 fish it is probable that the l.l.  
 is a "detector" of minute  
 vibrations. *See* Labyrinth.

**Latex.** The milky fluid of  
 laticiferous cells. *Ex.* rubber.

**Laticiferous.** Conveying  
 latex. **Latirostral.** Broad-

beaked. **Latitude.** A point on one of the circles drawn around the earth parallel to equator; all points on the same line have the same latitude. **L., degree of.** 68-704 miles at equator. 69-407 miles at the poles.

**Laurentian.** Modified ancient rocks characterizing the St. Lawrence area and containing very early forms of life.

**Lava.** Molten rock which overflows from volcanic vents.

**Law.** A statement of invariable sequence under given conditions. A generalization. *Cf.* Hypothesis.

**Lead, ch. el. Pb. Metal.** *At. no.* 82; *at. wt.* 207.220.

**Leaf, scale.** A cataphyllary leaf that protects the bud.

**Leaf-stalk.** A petiole (*q.v.*).

**Lecithin.** A phospholipoid or phosphorized fat in protoplasm and yolk. **Lecithoblast.** The yolk-containing blastomere of an ovum. **Lecithocœl.** Segmentation-cavity of a holoblastic ovum. **Lecithophore.** Yolk entoderm.

**Legume.** A pod. A dehiscent, one-chambered, many-seeded, two-valved carpel. *Ex.* pea; bean. **Legu-men, -min.** A proteid of peas, beans, etc. **Leguminosæ.** An O. of pl. with irregular flowers and with fruit as a legume (*q.v.*).

**Leiotropic.** *Læotropic* (*q.v.*).

**Lemur.** A primate. **Lemuridæ.** A *fam.* of lemuroidæ, between the monkeys and insectivora. **Lemurinæ.** A *sub-fam.* of lemuridæ. **Lemuroidea.** A *sub-o.* of primates.

**Length, units of.** (1) Red cadmium radiation of w.-l. 6438-4696 A.U., or 1/1,553,164 metre, or 0.00064384696 mm. (2) Blue cadmium radiation of

w.-l. 1/2,083,372 metre. (3)

X. unit (X.U.) =  $10^{-11}$  cm.

(4) Angstrom unit  $10^{-8}$  cm.

(5) Milli-micron ( $m\mu$ )  $10^{-7}$  cm.

(6) Micro-micron ( $\mu\mu$ )  $10^{-10}$

cm. or  $10^{-12}$  metre. (7) Micron

( $\mu$ )  $10^{-4}$  cm. or  $10^4$  A.U. (8)

Centimetre (cm.) 0.3937 inch

or  $15531.6413 \times$  w.-l. red cad.

radiation. (9) Metre (*q.v.*)

1/10,000,000 of distance from

pole to equator along a meri-

dian or  $1.55316413 \times 10^6$  red

cad. w.-l. (10) Light year or

5,878,310,400,000 (approx.  $6 \times$

$10^{12}$  miles or  $9.46 \times 10^{12}$  kil.).

(11) Parsec; 3.26 light-years

( $1.916 \times 10^{13}$  mi.). (12) Kilo-

parsec, 1000 parsecs; 3260

light-years;  $1.916 \times 10^{16}$  mi.

(13) Ast. unit.  $9.29 \times 10^7$  mi.

**Lens.** (1) A transparent

substance with one, or both

sides, curved to refract rays of

light. (2) Transparent part of

eye which focuses light on to

retina. (3) Modified cornea in

front of element of compound

eye.

**Lenticel.** Ventilating pore

in roots and stems. **Lenticular.**

Resembling a double-convex

lens. **Lenticulate.** Having

lenticels (*q.v.*). **Lentigerous.**

Having a lens. **Lentigin-ose,**

**-ous.** Speckled with dark spots.

**Lepidodendron.** Fossil tree

akin to club-moss; present in

coal. **Lepidophyte.** Fossil

fern. **Lepidoptera.** O. of in-

sects with two pairs of scale-

covered wings. **Rhopalocera**

(butterflies) and **Heterocera**

(moths). **Lepidosiren.** The

Amazon lung-fish (dipnoi). A

transitional type between

water- and air-breathing verts.

**Lepid-ote, -otic.** Covered with

scales. *Per.* acid in butterfly

scales. **Lepidospondylous.** Am-

phicelous (*q.v.*). Pseudocentrous.

**Leptocardii.** Cephalochordata. *Ez. amphioxus*. Worm-like verts. **Leptocephalus.** Larva of eel. **Leptocercal-**  
**-ous.** Having a slender, tapering tail. **Leptome.** Phloem. Bast. **Leptonema.** Leptotene (*q.v.*). **Leptophloem.** Rudimentary bast. **Leptophyllous.** Thin-, slender-leaved. **Leptostraca.** Crustaceans with ancestral features linking palaeozoic forms to modern malacostraca. **Leptotene.** *Syn.* leptonema. *App.* early stage in germ-cell maturation (meiosis) when chromatin is in fine threads.

**Leucine.\*** An amino-acid formed during putrefaction. **Leucin.** A nitrogenous cell-substance. **Leucite.** A colourless plastid. **Leucoblast.** Parent-cell of white blood-corpuscle, present in bonemarrow. **Leucocyan.** A dark-blue pigment of algæ. **Leucocytes.** Amœboid, nucleated, white blood-cells or corpuscles. *Syn.* amœbocyte; leucoblast; microphage; myeloblast; myelocyte; plasmocyte. *Cf.* Phagocyte. **Leucocytogenesis.** Formation of leucocytes. **Leucophore.** A pigment cell. An irodocyte. **Leucoplast-, -id.** Colourless plastid in cells of underground parts of a pl. which, on exposure to light, develop into chromatophores, amyloplast-s, -ids, chloroplast-s, -ids, and chromoplast-s, -ids, at same time turning green.

**Lever.** A rigid bar for applying force at a mechanical advantage. When in equilibrium the "power"  $\times$  length of its

\* Leuc. Also as Leuk.

arm of the lever is equal to the "weight"  $\times$  length of the other arm. The three orders of lever are according to the relative positions of the power, P., the weight, W., and the fulcrum, F, thus: (1) P.F.W.; (2) F.W.P.; (3) W.P.F.

**Liber.** Bast.

**Libido.** The sexual urge.

**Lichen.** A compound (symbiotic) pl. consisting of a holophytic alga (chlorophyceæ) and a fungus (ascmycetes). The alga hands on carbonaceous compounds to the fungus, receiving from the latter water and mineral salts.

**Life.** No complete definition of "life" or "living matter" is possible, since no character is its exclusive appanage. The characters that especially distinguish a pl. or an an. from not-living matter are metabolism (*q.v.*), growth, reproduction, and the power of adaptation or adjusting internal to external relations (environment).

The following definitions have been attempted: (1) The sum-total of functions which resist death. (2) A vortex of chemical and molecular change. (3) A physico-chemical mechanism. (4) The sum-total of reflex actions to environment. (5) A transformer of energy. (6) An enduring, insurgent activity, growing, multiplying, developing, enregistering, varying, and evolving. (7) A configuration of matter which absorbs energy acceleratively, without limit, when unconstrained. (8) A general name for a No. of complicated physical and chemical processes, not an added principle, a mysterious something over and above them. (9) A material system in which the transfer of energy is attended by effects conducive to the transfer and retardative of dissipation, in contrast to an inanimate material system the transfer of energy into which is attended by effects retardative of the

transfer and conducive to dissipation.  
(10) A dynamic equilibrium in a polyphasic system.

**L. elements.** Those always present in protoplasm are: C, H, O, N, S, P, K, Mg, Ca, Na, Cl, Fe, Si. Those generally present are: I, Mn, Br, F. Those sometimes present: Al, Cu, B, Ba, Co, Li, Ni, Ra, Sr, Zn, As, and Pb. Those very rarely, and probably adventitiously present: Ce, Ch, La, Mo, V, Nd, Pr.

**Ligament.** A strong, flat-tish, fibrous band of tissue uniting and fixing bones, organs, and shells.

**Light.** Luminous radiant energy (*q.v.*). Electromagnetic waves (*q.v.*) (and ? corpuscles) that stimulate retina and arouse visual sensations. W.-l. varies from 4000 A.U. (blue) to 8000 A.U. (red), with corresponding frequencies  $8 \times 10^{15}$  (blue) to  $4 \times 10^{15}$  (red). The vel. of all light-waves is approx. 186,229 miles/sec. or  $2.99776 \times 10^{10}$  cm./sec. See Photon; Proton; Quantum.  
**L.-pressure.** The p. of sunlight is about 2.6 lb. per sq. mile or 114,700 tons on exposed earth-surface. See S.L.

**L.-year,** see Length.

**Lignicolous.** Living on or within wood. **Lignin.** The strengthening material in pl. cell-walls which forms cellulose (*q.v.*) and wood. *Syn.* lignone. **Lignivorous.** Wood-devouring. **Lignone.** *Syn.* lignin (*q.v.*). **Lignose.** Cellulose.

**Ligula.** *Syn.* ligule. A tongue. A structure (1) between labial palps of insects; (2) in the brain; (3) a water-conserving structure

(stipule) near base of a ligulate leaf; (4) a scale; (5) lobe of parapodium. **Ligule.** *Syn.* ligula (*q.v.*).

**Limace.** The concealed vestigial shell of slugs. **Limacine.** *Per.* or resembling a slug.

**Limicolous.** Living in mud. **Limivorous.** Feeding on mud.

**Limnetic.** Inhabiting marshes. **Limno-biotic, -philous.** Dwelling in marshes. **Limno-plankton.** The plankton (*q.v.*) of pond, marsh, and lake. **Limulus.** The king-crab; an arachnid (*q.v.*).

**Line of force.** One of the (imaginary) lines in a "field of force" along which electromagnetic forces act. The direction of the field at any point is the tangent to the line at that point.

**Linin.** An achromatic, oxyphilic substance of nuclei. *Syn.* lanthanin; nucleoplasm; oxychromatin.

**Linkage, ch. *Per.*** valency connections or to bonds between atoms in a mol. *Bio.* Linking of adjacent genes of a chromosome.

**Lipase.** A lipolytic enzyme which decomposes fats and oils with production of sugar. *Syn.* steapsin. **Lipochrome.** A coloured fat. **Lipogenous.** Fat-producing. **Lipoid.** Fatty. **Lipolytic.** Fat-dissolving. **Lipomerism.** Suppression of segmentation. Coalescence of segments. **Lipostomy.** Absence of mouth. **Lipoxenous.** Leaving a host while still undeveloped.

**Liquid.** A state of aggregation of matter in which there is definite volume but no definite form and in which there is free movement of the mols.

among themselves. *Cf.* Gas; Solid.

**Lithite.** An otolith (*q.v.*) inside balancing organs such as litho-, oto-, tentaculo-cysts, etc.

**Lithium**, *ch. el.* **Li.** The lightest metal known. *At. no.* 3; *at. wt.* 6.940. **Lithocyst.** The sac containing lithites. **Lithodesma.** An ossicle in bivalves. **Lithodomous.** Living amid rocks. **Lithogenous.** *Per.* formation of rocks. **Lithophagous.** Stone-swallowing (birds); stone-eroding (molluscs). **Lithophilous.** Growing on stone or rock. **Lithophyll.** A fossil leaf or leaf impress. **Lithophyte.** A pl. that grows in rocky ground. **Lithotomous.** Rock-boring an.

**Litre.** Measure of vol. 35.196 fl. oz. 61.028 cub. in. 1000 c.c. 1000 grammes of water.

**Littoral.** The sea-shore and sea to a depth of 600 ft. Living on or near the coast. *Cf.* Abyssal; Coralline zone; Laminarian.

**Liver.** Man's largest gland. It forms and stores bile and glycogen; forms new, destroys effete, blood-corpuscles; forms urea; destroys poisons. **L-fluke.** Trematode which causes "rot" in sheep. **L-wort.** A bryophyte *Cl. hepaticæ*.

**Loculicidal.** Dehiscent dorsally through back of carpels.

**Lodicules.** Pair of scales at base of ovary in grasses, probably a reduced perianth.

**Loess.** A post-tertiary wind-deposited loam (S.L.).

**Loment.** *Syn.* lomentum. A pod or legume constricted between the seeds. **Lomenta-**

**ceous.** Having lomenta. **Lomentum.** Loment (*q.v.*).

**Longipennate.** Having elongated feathers or (*bot.*) wings. **Longirostral.** Long-beaked; long-snouted.

**Longitude.** Point on a circle drawn round the earth through both poles and cutting equator at a right angle. All places on any circle have same l. *Syn.* meridian.

**Lophobranchiate.** With tufted gills. **Lophocercal.** Diphyrcercal (*q.v.*). **Lophodont.** Having grinding teeth with ridges transverse to long axis of jaw. *Cf.* Bunodont. **Lophophore.** Supporting base of a tentacle. **Lophoselenodont.** Having teeth with crescentic ridges on grinding surfaces. **Lophotrichous.** Having several flagellæ at one end.

**Lore.** Space between bird's bill and eyes. **Loricæ.** Protected by shell or scales.

**Loxodont.** Having molar teeth with shallow grooves between ridges.

**Luciferase.** Enzyme of cert. luminiferous animals which, in conjunction with *Luciferin*, a protein, causes luminescence (S.L.). **Lucifugous.** Shunning light.

**Lumbar vertebræ.** The vert. in the loins, immediately below the vert. supporting the ribs.

**Lumen.** *Lux.* (1) Luminosity (S.L.) unit =  $1.496 \times 10^{-8}$  watts. 12.57 lumens = 1.0 spherical candle power. 1.0 lumen c.p. emits  $4\pi$  lumens. Degree to which a surface is lit up. Given same illumination a white surface has higher illumination than a black. (2) Bore of artery, pipe, stalk, etc.

**Lung.** Respiratory organ of

air-breathing verts. The respiratory organ of *pulmonata*, which, however, does not correspond *morphologically* with vert. lung. **L.-book.** Respiratory organ of invertebrates, such as scorpions and spiders. **L.-fish.** A dipnoan (*q.v.*).

**Luteal.** *Per. corpus luteum* (*q.v.*). **Lutecium, ch. el.** Lu. Metal. *At. no.* 71; *at. wt.* 175.0. **Lutein.** Yellow pigment of yolk and cells of *corpus luteum* (*q.v.*). **Luteogenic.** *App.* substances, such as hormones of anterior pituitary gland, that stimulate secretion by *corpus luteum* (*q.v.*).

**Lux.** See Lumen.

**Lychnidiate.** Luminous.

**Lymph.** An alkaline, coagulable, colourless fluid of the lymphatic vessels. *Syn.* plasma. See Lymphatics. **L.-hearts.** Contractile expansions of a lymph-vessel which propel the lymph in lower verts. (*e.g.*, amphibian).

**Lymphatic glands.** Glands that produce lymphocytes (*q.v.*). **Lymphatics.** Special system of tubes that conducts the lymph from the tissues to the venous system. **Lymphocytes.** Small, mononuclear, colourless cells of lymph. **Lymphogen-ic, -ous.** *Per.* or formed by lymph-glands. **Lym-**

**phoid.** *Syn.* adenoid. *Per.* lymph or lymphatics.

**Lyocytosis.** Histolysis by extra-cellular digestion as in insect metamorphosis. **Lyophil.** *App.* solids that readily pass into liquid state. Strong affinity between a colloid and surrounding liquid. **Lyophobe.** *App.* solids that remain dry and do not readily take up water. Also to colloids that have weak affinity for the liquid in which they are dispersed. *Cf.* Lyophil. **Lyotrope, -tropic.** Dependent on forces existing between the constituents of a solution, not on their qualities as separate entities. *App.* solutions which are dependent on changes in the solvent.

**Lyse.** To liquefy. **Lysigenous.** Lysogenous (*q.v.*). **Lysin.** A chemical substance that disintegrates cells and bacteria. **Lysinogenetic.** Inducing liquefaction. **Lysis.** Liquefaction and disintegration. **Lysogenesis, -ous.** *App.* formation of tissue cavities through degeneration of cell-walls. *Syn.* lysigenous.

**Lyssa.** *Syn.* lytta. (1) Rabies. (2) A cartilaginous worm-shaped structure beneath tongue of carnivorous mammals. **Lytta.** *Lyssa* (*q.v.*).

## M

**Mace.** Arillus (*q.v.*).

**Maceration.** Removal of tissues from bone by putrefaction.

**Macandrous.** Having large m. sex organs.

**Macaner.** Large m. ant.

**Macergate.** Large worker (ant)

**Macrobiotic.** Long-lived.

**Macroblast.** Large cell. **Macrocephalic.** Having large cotyledons. Large-headed. A human head above 1450 c.c. (*mesocephalic*, 1350-1450 c.c.; *microcephalic*, below 1350 c.c.). **Macroconjugant.** The large, f. gamete as *cf.* c. m. *microconjugant*. **Macrocosm.** The

universe. **Macrocyte**. Large cell, especially a large red blood-corpuscle. **Macrogamete**. Megagamete (*q.v.*). **Macrogametocyte**. Megagametocyte (*q.v.*). **Macrogamy**. Syngamy between full-grown individuals. *Cf.* Hologamy. **Macrogyne**. Large f. ant. **Macromere**. Large cell at vegetative pole of ovum. *Opp.* micromere. **Macront**. Parent cell of macrogamete. **Macronucleus**. Large, vegetative nucleus of gamete. *Syn.* meganucleus. **Macrophage**. Large mononuclear phagocyte. A clasmatocyte. **Macropodous**. Having a large foot or long stalk or hypocotyl. **Macrosmatic**. Highly-developed olfactory sense. **Macrosporangiphore**. Support of macrosporangium. **Macrosporangium**. Sporangium containing macrospores. **Macrospores**. Megasporeangium. **Megaspores**. Large anisospores. Large (usually f.) spores. **Macrosporophore**. Support of macrosporangium. Also *syn.* with macrosporophyll. **Macrosporophyll**. f. gametophyte. **Macrosporophore**. Gametophyll. *Cf.* microsporophyll. **Macrotherms**. Tropical pl. Megatherms.

**Macula lutea**. Yellow spot. Point in retina of most perfect vision present only in monkeys, apes, and men, among mammals.

**Madrepores**. Corals. Stone-canal plates in echinoderms.

**Magdalenian man**. Man, c. 30,000 B.C., of highest European palæolithic culture. (He followed aurignacian and preceded cromagnon man.)

**Maggot**. Worm-like larva (*q.v.*).

**Magma**. Molten rocks. Crude mineral paste.

**Magnesium**, *ch. el.* Mg. A light, white metal which, in form of ribbon or powder, burns with a dazzling white light.

**Magnet**. An iron-attracting body which, freely-suspended, places its long axis N. and S. **Magnetic field**. Line-of-force region around magnet or current-carrying wire. **M. flux**. No. of lines of force around a magnet; the product (in *maxwells*) of *magneto-motive force* and *circuit permeance*. **M. force**. Attraction or repulsion exerted by a m. field upon unit m. pole. **M. induction**. Magnetism temporarily induced by proximity of a magnet. **M. poles**. (Not fixed.) The N. m.p. of earth is now: N. Lat. 71°, W. Long. 96°; the S. m.p.: S. Lat. 72.5°, E. Long. 156°. **M. pole, unit**. Pole which exerts a force of 1 dyne upon an equal pole 1 cm. away. **M. reluctance or resistance**. Opposition to m. flux. **Magnetic permeance**. **M. remanence**. Magnetism remaining after magnetizing current ceases.

**Magnetism**. Steady motion of electrons in small orbits in practically parallel planes. If orbits are nearly in same plane, the body is *paramagnetic* (*ex.* O, Al). If orbits can influence each other the body is *ferromagnetic* (*ex.* Co, Fe). If majority of electronic orbits are in parallel planes with similar revolutions kept going by the mutual attraction of the orbital systems, the body is a *permanent magnet*. **Magneto-motive-force**. Sum of magnetizing forces in a current-carry-

ing coil. It =  $1.256 \times$  current  $\times$  no. of turns in coil. **Magnetron.** Thermionic valve in which a magnetic field governs electronic flow.

**Mala.** *Per.* jaw, mandible, maxilla, or beak.

**Malacoid.** Soft. **Malacology.** Study of molluscs. **Malacophilous.** Pollinated by snails. **Malacostraca.** *Sub.-cl.* of crustaceans. *Ex.* crab.

**Malaxation.** Dismembering. Process by which one insect (*e.g.*, wasp) stings another, massages the part to distribute the paralyzing poison, then cuts the victim into pieces as food for its larva.

**Male.** An organism (or organ) producing sperm elements capable of fertilizing a f. (*q.v.*). *Ex.* stallion, stamen. **M.**

**flower.** Flower bearing stamens but not pistil. (A f. flower bears pistil but not stamens.) **M. pronucleus.** Nucleus, with half its original chromosomes, of a spermatozoon that has shed its tail during entry into ovum.

**Malleability.** Property enabling a body to be beaten out into plates. *Ex.* gold, which can be beaten into leaves 1/300,000 in. thick.

**Malleus.** Hammer-shaped ossicle of ear. Part of rotifer gizzard.

**Maltase.** Ferment converting maltose, sucrose, etc., into hexose sugar. **Maltose.** A dextro-rotatory sugar ( $C_{12}H_{22}O_{11}$ ) formed by action of diastase on starch.

**Mamma.** Milk-secreting glands. **Mammary gland** (a modified sweat gland). **Mammal.** A warm-blooded, hairy, heterodont, and, with exception of monotremes, viviparous

vert. the f. of which suckles its young. There are over 2,700 species. **Mammilla.** A nipple-like process. A spinneret (*q.v.*).

**Man.** *See* Hominidæ.

**Mandible.** Lower jaw. A paired mouth-appendage. *See* Chelicera; Maxilla.

**Manganese, ch. cl.** Mn. Metal. *At. no.* 25; *at. wt.* 54.930.

**Maniccate.** Densely covered with hair.

**Manometric flame.** Gas flame flickering synchronously with sound-vibrations.

**Mantle.** Pallium (*q.v.*). Test (*q.v.*). Back feathers of bird.

**Manyplies.** Third chamber of ruminant stomach. **Omasus.** Psalterium.

**Marcescent.** Having parts (*e.g.*, calyx) that persist after withering.

**Marrow.** Vascular tissue of bone cavities which forms the red blood-corpuscles.

**Marsupials.** Pouch-bearing (lower) mammals whose young are born in a "larval" state.

**Metatherians.** *Ex.* kangaroo.

**Marsupium.** Any bag-like structure. Pouch of marsupials. Gill-cavity. A protecting organ of archegonium.

**Masochism.** Exaltation of sex-passion by submission to pain. *Opp.* sadism.

**Mass.** Capacity of a body to acquire kinetic energy. Inertia (*q.v.*). The measurement of mass is the force with which it is attracted to the earth—*i.e.*, its weight.

m. is one of the three fundamental quantities (length, time, mass) on which all physical measurements are based; it is the quotient of wt./g. acceleration. It is, further, a measure of the quantity of matter in a body, as determined by comparing the changes in velocities that result when the body and a standard body im-



plings. *m.* is constant (except at very high speeds) whereas *wt.*, being the force with which the earth attracts the *m.* varies according to its distance from earth's centre. A lb. *weight*—*e.g.*, on earth—is less than a lb. *wt.* on Mars, but more than a lb. *wt.* on Jupiter, but the *m.* is the same on all three planets. *m.* may be regarded as the product of density and volume; or the no. of mols. in a given vol. Energy (radiation, photons) has *mass*. In the visible universe energy mass is, however, less than 1.0% of matter mass. There are really two aspects of *m.*: the fixed or rest *m.* retained by a body when at rest, and a variable or energy *m.* dependent on its speed. Hence at bottom, *m.* is an effect of *electrons in motion*. An electron at rest would have no *m.* and an electron at speed of light would have infinite *m.* At 1 cm. per sec. an electron has unit *m.* and unit energy, at 2 cm. per sec. it has 4 units of *m.*, at 3 cm. per sec., 9 units, and so on, *m.* being = square of speed as long as this is small compared to speed of light ( $2.997 \times 10^{10}$  cm. per sec.). Under these conditions *m.* is constant. At speeds nearing that of light the *m.* increases much faster than the sq. of the vel. It is found that the ratio *e/m.* (Charge/*m.*) for the particles ejected by radium diminishes as their vel. increases. The charge is known to remain constant, therefore *m.* must increase with vel. and must be an electronic phenomenon. Electrons have been known to attain a speed of 99.8 p.c. of speed of light. The unit of *m.* is 1 gramme; the elec. unit  $10^{-11}$  gramme. The following are examples of mass of bodies in grammes: electron,  $9.106 \times 10^{-28}$ ; proton,  $1.672 \times 10^{-24}$ ; H mol.,  $3.33 \times 10^{-24}$ ; O mol.,  $52.8 \times 10^{-24}$ ; earth,  $6096 \times 10^{24}$ ; sun,  $2024 \times 10^{30}$ ; solar system,  $20267 \times 10^{33}$ ; *our* (milky way) universe,  $29 \times 10^{43}$ . See Matter; Energy; Metre. See Mass, active (S.L.).

**Mass number.** *At. wt. (q.v.). M., standard of.* See Metre.

**Mastax.** Horny pharynx of rotifers. Gizzard.

**Mastigium.** Any posterior lash-like organ.

**Mastoid.** Any nipple-like process—*e.g.*, that of temporal bone.

**Masturbation.** Inducing the sexual orgasm by manipulation

of the external genital organs, or by means other than through the normal congress of the sexes. Manustupration. Onanism.

**Masurium, ch. el. Ma. Metal.** *At. no. 43; at. wt. 99 (?)*.

**Materialism.** Theory that universe is self-supporting and self-sufficing and that its phenomena are in terms of matter and energy. *Cf.* Mechanism.

**Matter.** Space-filling substance which affects the senses and has mass and *wt.* An elec. manifestation in relation to other *m.* An assemblage of forces. *m.* is a series of waves in closed orbits; *energy* is a series of waves in open lines. With energy, *m.* is the constituting substance of the universe. The basic els. of *m.* are *protons* and *electrons (q.v.)*, the various combinations of which make up some 92 *kinds* of *m.*, the elements. See Mass; Energy; Atom.

**Maturation.** Final stage in meiosis (*q.v.*), during which chromosomes are quantitatively reduced from diploid to haploid No.

**Maxilla.** Upper jaw-bone. Paired appendages of arthropods. Palpi.

**Maxwell.** Unit of magnetic flux.

**Mean free path.** Average straight-line distance travelled by a gas mol. At standard temp. and p. it is  $1.76 \times 10^{-5}$  cm. for H, and  $9.4 \times 10^{-4}$  cm. for O.

**Meatus.** A passage—*e.g.*, that of ear.

**Mechanical equivalent of heat.** Principle that a definite quantity of mechanical work can be derived from, or converted into, and is eq. to, a given quantity of heat.

*Ex. a lb. wt. falling through 772 ft. generates heat on striking the ground that will raise 1 lb. water 1° F. Conversely, amount of heat required to raise 1 lb. water 1° F. can raise 1 lb. wt. through 772 ft. Hence 772 ft. lbs. is the mechanical equivalent of heat. Its value expressed in joules (q.v.) per calorie (q.v.) is: at 15° C. = 4.1852; at 20° C. = 4.1855, or a mean for 0° C. - 100° C. = 4.185.*

**Mechanics.** Study of action of forces on bodies. Dynamics and statics. **Mechanism.** Theory that all vital phenomena are mechanically determined and lie entirely within the physico-chemical sphere. *Cf.* Materialism; Determinism.

**Medulla.** A central part. Bone-marrow. Pith. Spinal cord. White matter of brain. Deep part of kidney and adrenal. *M. oblongata.* Hinder part of brain concerned with vital reflexes (breathing, circulation, swallowing, etc.).

**Medusa.** Jelly-fish. Free-swimming sexual zooid of hydrozoa.

**Mega.** Prefix meaning "large" or "million-fold."

**Megacephalic.** Macrocephalic (q.v.).

**Megagamete.** *Syn.* macro-, oo-gamete; oosphere; ovum (*cf.* Microgamete). Large f. egg developed from Megagametocyte.

**Mother-cell** of megagamete, itself the product of a merozoite. **Megakaryocyte.** Giant cell with one large nucleus and many nucleoli.

**A marrow-cell.** **Megaloblast.** Giant erythrocyte. **Megalo-**

**cyte.** Giant-cell. **Megalopa.** Larval stage of crustaceans.

**Megalosaur.** Large triassic dinosaur. **Megasporangium.**

Sporangium containing megaspores. *Syn.* ovule; oophridium; nucellus. **Megaspore.** *Syn.* macrospore; embryo-

sac; mother-cell. Large (usually f.) spore of heterosporous pl. Parent-cell of asexual spore (seed-pl. and some ferns) also of large f. gametophyte (containing f. gametes). In ligulates it is the spore produced by megasporangium and producing the prothallus. **Megasporophyll.** Spore-leaf bearing megasporangia. **Megatherms.** Tropical pl. **Megazoospore.** Large flagellated spore; an algal zoogonidium. **Megohm.** A million ohms.

**Meiosis.** Mitosis in which nuclei of maturing gametes divide twice and chromosomes once, so that latter are reduced from diploids to haploids. **Meiotaxy.** Suppression or reduction of parts.

**Melanin.** Dark pigment of retina, skin, and hair. **Melanism.** *See* Albinism. **Melanoblast, -cyte, -phore.** Cell producing, or containing, melanin.

**Melli-phagous, -sugent, -vorous.** Eating or sucking honey.

**Melting, latent heat of.** *See* Fusion.

**Membranous labyrinth.** Cavity of internal ear surrounded by *perilymph* and containing *endolymph* and representing an original *otocyst* which has evolved into *utricle*, *sacculle*, *endolymphatic duct*, *semicircular canals*, and *cochlea*. *See* Labyrinth.

**Mendelism.** A principle of heredity.

In the first generation of a cross between two individuals with different characters, one of the characters alone appears, the *dominant* (Y); the other lies latent and is called *recessive* (y). (The characters may be here supposed to be "yellowness" and "greenness" of colour in pea seeds.) If the crossing individuals

fertilize themselves, another generation appears in which  $Y$ 's and  $g$ 's appear in proportion of 3 to 1 or 75 *p.c.*  $Y$ 's and 25 *p.c.*  $g$ 's. If these be again self-fertilized, the offspring of the crossed  $g$ 's are  $g$ 's and produce, self-crossed,  $g$ 's ever afterwards in *all* succeeding generations; the offspring of the  $Y$ 's are  $Y$ 's but of two kinds: (1) pure  $Y$ 's, which, like the pure  $g$ 's, produce, self-crossed,  $Y$ 's ever afterwards in *all* succeeding generations, (2) apparent, but really hybrid,  $Y$ 's containing recessive ( $g$ ) characters and, self-crossed, producing once again  $Y$ 's and  $g$ 's in the proportion of 3 to 1 or 75 *p.c.*  $Y$ 's and 25 *p.c.*  $g$ 's. The determining factors are the genes (*q.v.*). Yellowness is due to a factor " $Y$ ," greenness to a factor " $g$ ." Fusion of a  $m$ . gamete with factor " $Y$ " and a  $f$ . gamete with factor " $Y$ " is a yellow-seed plant  $YY$ .  $m$ . and  $f$ . gametes, each with factor " $g$ ," fuse to form a green-seed *pl. gg*. By crossing  $YY$ 's with  $gg$ 's, there arise, in the first ( $F$ . 1) generation, hybrids,  $Yg$ 's. In their formation, a segregation takes place such that gametes,  $m$ . or  $f$ ., are produced of two kinds  $Y$  and  $g$  in equal Nos.  $Y$  and  $g$ , being alternative, are called *allelomorphs*. The offspring in the next,  $F$ . 2, generation, which result from the chance union of these gametes in pairs are, by the *laws of probability*, in the proportions 1  $YY$ :2  $Yg$ :1  $gg$ . Thus plants (*homozygotes*) pure in yellow seeds  $YY$  and plants pure in green seeds,  $gg$ , and plants (*heterozygotes*) mixed in seed-coloration, cross-breeds  $Yg$ , are formed. These individuals  $Yg$  are themselves often indistinguishable from the pure form  $YY$ . When this is so the factor  $Y$  is called dominant (as mentioned above) and the factor  $g$  recessive. See Sex.

**Meniscus.** Concavo-convex lens or lens-shaped body.

**Menotaxis.** Orientation consisting in maintenance of a constant angle to a source of stimulation.

**Menstruation.** *Syn.* catamenia. Phenomenon in *f.* mammals at period of potential fecundity consisting in the rhythmic (usually at monthly intervals) shedding of part of lining membrane of uterus

together with the unfertilized ovum.

**Mercury.** (1) *Ch. el.* Hg. Liquid metal. *At. no.* 80; *at. wt.* 200-610. (2) A *pl.* (3) Innermost planet.

**Mericaip.** One of the single-seeded constituent carpels of a schizocarpic fruit. See Fruit.

**Meridian.** A circle passing through N. and S. pole of earth. Circle passing through two poles of celestial sphere.

**Meristem.** Undifferentiated *pl. tissue* present especially (pro-meristem) at growing points and characterized by rapid cell-divs. See Phellogen.

**Meristic.** *Per.* or divided into sections.

**Meroblastic.** *Per.* partial segmentation of ova. Cf.

Holoblastic. **Merocytes.** Nuclei formed by division of supernumerary sperm nuclei in unsegmented part of ovum.

**Merogony.** Development of an enucleated zygote, or of an ovum devoid of *f.* pro-nucleus.

**Microgamy.** **Meroplankton.**

Plankton that is near surface only part of year. **Merosome.**

See Metamere. **Merozoite.**

Div. product of asexual schizont (*q.v.*). Cf. Zoospore.

**Mesarch.** Protoxylem surrounded by metaxylem. Ex-

arch and endarch. **Mesencephalon.** Mid-brain. **Mesenchyme.** Vascular connective

tissue intermediate between ecto- and ento-derm, from

which arises mesoderm. *Syn.* mesoblastic tissue; meso-

glœa. **Mesendoderm.** Cells giving rise to meso- and endo-

derm. **Mesenteron.** Mid-gut —i.e., gut excluding stomo-

and procto-dæum. **Mesentery.** Fold of peritoneum supporting

intestines. Body-wall partition in coelenterates.

**Mesiad.** *Per.* mid-plane.

**Mesobenthos.** Life between 100 and 500 fathoms. **Mesoblast.** Middle layer of the three embryonic cell-layers. **Mesoderm.** *See* Mesoglaea. **Mesocarp.** Middle layer (between epi- and endo-carp) of pericarp. **Mesocephalic.** *See* Macrocephalic. **Mesoderm.** Layer of cells between mesoblast (*q.v.*). Ecto- and endo-derm. **Mesoglaea.** Jelly-like, non-cellular tissue between ecto- and endo-derm present in invertebrates and corresponding to vert. *mesoderm*. **Mesonephros.** Wolfian body. Second stage of three renal systems in verts. **Mesophyll.** Green chloroplast-containing layer of leaf between epidermal layers. *Syn.* diploë. **Mesoplankton.** Plankton below 100 fathoms. **Mesoplast.** Nucleus. **Mesostomium.** Mid-part of worm between neck and anus. **Mesothorium, ch. el.** Radioactive disintegration products of thorium. *Ms.Th.I. At. no. 88; at. wt. 228. Half-life-period (H.L.P.) 6.7 years. Ms.Th.II. At. no. 89; at. wt. 228. H.L.P. 6.2 hours. Mesozoic. Secondary geo. era including triassic, jurassic, and cretaceous.*

**Metabolism.** Sum-total of ch. changes in living matter. *Anabolism (q.v.) plus katabolism (q.v.).* **Metastasis.** **Metacarpus.** Five bones between digits and wrist. **Mesopodium.** **Metæsthetism.** Theory that consciousness is an ev. product of matter and energy. **Metagenesis.** Alternation of generations (*q.v.*). *Cf.* Heterogamy.

**Metal.** A lustrous, opaque solid at ordinary temp. (except mercury). Metals are good conductors of heat and elec., their atoms readily part with electrons, and are capable of replacing H in an acid and of forming a base with O.

**Metamere.** A segment. **Somite (q.v.).** **Merosome.** **Metamorph-ic, -ism.** *Per* or condition of change; transformation; evolution; ontogeny; phylogeny; embryology. Change in rock constitution by water, heat, pressure, etc., especially of sedimentary rocks by intrusion of igneous. **Metamorph-osis, -y.** (1) Transformation. Evolution. Change of form and structure, especially in insects, amphibians, etc. *Ex.* grub—pupa—imago; tadpole—frog. **Ontogeny.** **Phylogeny.** (2) Interference with normal floral symmetry. (3) Internal chemical changes, oxidation, reduction, etc. **Homoeosis (q.v.).** **Metanephros.** Third and last stage in ev. of vert. kidney. **Metaphysics.** The discussion of "being," and of ultimate causes transcending experience. **Metaphyte.** Multicellular pl. *Cf.* protophyte. **Metaplastm.** Lifeless matter in protoplasm. *Syn.* allo-, para-, deuto-plasm. **Metapodium.** **Metacarpus.** **Metatarsus.** Hinder part of molluscan "foot." **Acropodium.** **Metapterygium.** Posterior fin-cartilage of paired fins. **Basipterygium.** **Metasitism.** (1) Change from feeding on inorganic matter (pl.) to feeding on organic matter (an.). *Cf.* Metatroph. (2) Circulation of nutrient material within a cell or cell-

group. **Metastasis**. Transference of function from one organ to another. Change of state. **Metabolism**. **Metastomium**. Post-anal part of worm. **Metatarsus**. Five foot-bones between toes and ankle. Tarsus of hinder legs in insects. **Mesopodium**. **Metatheria**. Marsupials. **Metatroph**. Feeding on organic matter. Saprophytism. *Cf.* **Metasitism**. **Metazoa**. Many-celled an. *Cf.* Protozoa, Metaphyte. **Metazoea**. Larval stage of crustaceans.

**Metencephalon**. Cerebellum and pons. Hind-brain.

**Meteor**. Metallic (iron or siliceous) body travelling at high vel. through space which, on entering our atmosphere, is raised by friction to incandescence. It varies in size from a few grains to several tons. Shooting star. Aerolite.

**Metre**. Measure of length. 39·370147 in.  $10^6$  microns.  $10^9$  millimicrons. 3·280843 ft. (Br.),  $6·2137 \times 10^{-4}$  miles (Br. Stat.). 0·001 km. 100·0 cms.  $10^{10}$  angstroms. 1553164·13 times w.-l. of red cadmium line in air at 760 mm. p. and  $15^\circ$  C. **M.**, cubic.  $10^6$  c.c.  $10^9$  cub. mm. 61025 cub. in. 2204·6 lbs. of water. 35·31477 cub. ft. (Br.). 1·307954 cub. yd. (Br.). 0·001000027 cub. metres of water, at  $4^\circ$  C. and 760 mm. p., is = mass of 1 kgm. of platinum-iridium kept at Sèvres as the International standard of mass (*q.v.*). **M.**, square. 1550 sq. in. 10·7639 sq. ft.  $3861 \times 10^{-10}$  sq. mile.  $2471044 \times 10^{-10}$  acres.  $10^{-6}$  sq. km.  $10^6$  sq. mm.  $10^4$  sq. cm.

**Mica**. Silicate minerals with cleavage into very thin plates. ( $K_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$ .)

**Micella**. Complex mol. representing a structural unit of a colloid or cell. Biophor. Bioplast.

**Michelson-Morley theory**. (1) *Absolute* motion of earth not measurable. (2) Motion of earth exercises no effect on vel. of light. (1) and (2) are proved by the fact that (3) the two parts of a divided ray of light, each sent along a path at right angles to the other, travel at the same speed.

**Micraner**. Dwarf m. ant. **Micrergate**. Dwarf worker.

**Microbe**. A micro-organism. **Microcentrosome**. Centriole.

**Microcephalic**. *See* Macrocephalic. **Microconjugant**. m. gamete. *Cf.* Macroconjugant. **Microcosm**. World of the minute. *Cf.* Macrocosm.

**Microgamete**. m. gamete. **Spermogamete**. **Spermatozoon**. *See* Macrogamete, Syngamy. **Microgametoblast**.

Stage between microgametocyte and microgamete. **Microgametocyte**. Stage following merozoite, preceding microgametoblast. **Microgamy**.

Syngamy between minute gametes as in algæ and foraminifera. *Syn.* merogony. **Microgonidium**. m. gametocyte. **Sporont**. Gamont. **Microgyne**. Dwarf f. ant. **Microhenad**. Filter-passer (*q.v.*). **Micromere**. Cell near an. pole of ovum. *See* Macromere; Telolecithal. **Micromerozoite**.

Cell derived from microschizont and becoming the gametocyte. **Micro-micron**.  $\mu$ .  $10^{-9}$  mm. **Micro-millimetre**. Millimicron (*q.v.*). **Micron** ( $\mu$ ). Thousandth of a mm.  $1 \times 10^{-6}$  metre.  $1 \times 10^{-4}$  cm. 1000·0 micro-millimetres.  $1 \times 10^4$  angstrom units.

0.00003937 in. *See* Millimicron.

**Micront.** Precursor of microgamete.

**Micro-organism.**

**Microbe.** Germ. Bacterium.

Any microscopic organism.

**Microphone.** An electrico-acoustic instrument for converting, intensifying, and/or transmitting sound through agency of electric impulses.

**Microphyte.** A minute pl.

Bacterium. **Micropyle.** Opening

in membrane of unfertilized ovum through which

the sperm-cell enters. It is

usually single, but sometimes

(fish) there are a dozen.

Opening at apex of ovule

through which pollen-tube

enters. Opening in sponge for

escape of gemmules. **Micro-**

**sporangium.** Sporangium contain-

ing microspores. Pollen-

sac. Microsporophore. **Micro-**

**spores.** Small spores of Hetero-

sporous pl. Spores in micro-

sporangium. The spore which

produces a gametophyte bear-

ing m. gametes. Anisospore.

m. cell. Pollen-grain. In

ligulates it produces the pro-

thallial cell. *See* Mother-cell.

**Microsporophore.** Microspor-

angium (*q.v.*). Microsporophyll

(*q.v.*). **Microsporophyll.** m.

gametophyll (*q.v.*). A micro-

sporophore (*q.v.*). Androphyll.

Stamen. *Cf.* Macrosporophyll.

**Microzoon.** Protozoon. **Micro-**

**zoid.** The smaller, free-swim-

ming, individual of a unicel-

lular organism with dimorphic

zooids. **Microzoospore.** Small

flagellated spore. Planoga-

mete. Anisospore. **Micro-**

**zyme.** Biophor. An intra-

cellular micro-organism.

**Mildew.** Various types of

fungi.

**Mill.** Measure of length.

1760 yds. 5280 ft. 1609-34

metres. **M., sea (Br).** 6080-448

ft. *See* Sea-mile. **M., square.**

640 acres. 3,097,600 sq. yd.

27,878,400 sq. ft. 2.589998 sq.

km. 2589998.0 sq. met.

**Miliary.** Having numerous small granules.

**Milk teeth.** Temporary, deciduous teeth of mammals.

**Milky way.** Galaxy. The

particular "island universe"

of which our solar system is a

part.

To us it resembles a heaven-en-

circling belt of stars. It is disc-

shaped, our sun being some 37,000

light-years from the centre and a

little N. of the mid-plane. It makes

a complete revolution in 230 million

years, contains 145,000 million stars

averaging our sun in vol. and mass,

and has a long diameter of  $22 \times 10^4$

light-years. Its weight is  $c. 23.8 \times$

$10^{47}$  tons. There are some 2,000,000,

other (extra-galactic) island universes

resembling our galaxy.

**Millipede.** An arthropod.

*See* Myriapod. **Millepores.**

Corals.

**Milliampere.** Thousandth of

an ampere. **Milliard.** One

thousand million. **Millimi-**

**cron.** mm. *Syn.* micromilli-

metre.  $10^{-3}$  metre;  $10^{-2}$  cm.

0.00000039 in. 0.001 micron

(*q.v.*). 10 angstrom units.

**Milt.** Testes and sperm of

fishes. Soft roe.

**Mimetic.** *Per.* Mimicry. As-

sumption of colour-resemblance

as a means of self-protection.

**Mind.** Sum-total of con-

scious states. Normal func-

tioning of grey matter. Brain

in specific action. Cerebration.

Mentation.

**Mindel ice age.** Second stage

of European pleistocene glacia-

tion.

**Mindel-Riss period.** Second

European pleistocene inter-

glacial stage.

**Mineral.** A naturally-formed, usually solid (mercury, oil, and water excepted) inorganic compound of constant composition and properties.

**Miocene.** Epoch of *cænozoic* preceding *pliocene* and succeeding *eocone* (or *oligocene*).

**Mirage.** Optical illusion caused by reflection and refraction by heated air in which distant objects are apparently brought nearer and often inverted.

**Miscegenation.** Interbreeding.

**Mitochondria.** Minute bodies in karyoplasm. Chondriosomes (*q.v.*). Plastochondria. Spheroplasts. Mitome. Protoplasmic network. Cf. Paramitome; Reticulum. Mitoschisis. Mitosis. Indirect nuclear div. with formation of *amphister*, thread-formation of *chromatin* and its longitudinal segmentation into *chromosomes*, and splitting of these into daughter-chromosomes which separate into two groups. Karyokinesis. Karyomitosis. Cytodiareresis. Protomitosis. Cf. Amitosis. See Meiosis; Ookinosis.

**Mitral.** *Per.* valve between left auricle and left ventricle.

**Mixochromosome.** Fused chromosomes. Zygosome.

**Mixotropic.** Obtaining nourishment, in part as a holophyte, in part as a saprophyte or parasite.

**Mixopterygium.** The "clasper" (*q.v.*) middle lobe of pelvic fin. *Syn. myxopterygium.*

**Molar.** (1) Grinding tooth. See Dental. (2) *Per.* a mass of matter as *cf.* c. mols. *Ex.* molar motion. Mole. (1) Burrowing mammal. (2) Pigmented skin growth. (3) A

no. of grammes = mol. wt. of a substance. *Ex.* H, O, and Ur have moles of 2, 32, and 476 grammes respectively. **Molecular heat.** Heat required per mole to raise the temp. 1° C. See Specific heat. **Molecule.** Smallest particle of a substance which can still possess the distinctive properties of that substance.

The particles of a m. are atoms. The m. is a group of uncharged atoms united electrically—i.e., of atoms each with an = no. of protons and electrons.

The diameter of a H m. is 1/100,000,000 in., of a water m. 1/55,000,000 in. and there are some  $1.89 \times 10^{22}$  mols. in a pint of water. The mass of a H m. is  $3.33 \times 10^{-24}$  grammes, of an O m.  $52.8 \times 10^{-24}$  grammes. Mols. are in constant motion; thus, in a cubic millimetre of air at standard T. and P. there are  $4 \times 10^{16}$  mols. each of which sustains  $6 \times 10^9$  collisions per sec., travels a similar no. of paths averaging 1/341,000 in. at a mean vel. of 1466 ft. per sec.

**Molluscs.** Phylum of an. containing shell-fish, cuttle-fish, snails, etc. There are 62,700 species (*q.v.*) of molluscs and molluscoids.

**Molybdenum, ch. el. Mo.** Metal. *At. no.* 42; *at. wt.* 96.00.

**Moment.** Measure of rotative tendency of a force about a point. Torque of a force. **Momentum.** Quantity of motion; product of a body's mass into its linear vel. Angular m. is the moment of inertia about axis of rotation multiplied by the angular vel. *Moment of m.* is mass  $\times$  vel.—e.g., of a planet—multiplied by the radius of its path or the perpendicular from the sun on to the line of the planet's motion.

**Monad.** Any primitive uni-

cellular organism. An organic unit. Protozoon. Protophyte. Flagellate. Zoospore. A univalent atom or radicle. *See* Valency. **Monandry**. Having one m. partner or one stamen. *Cf.* Polyandry. **Monarch**. Having one protoxylem. **Moneron**. Un-nucleated unicell.

**Moniliform**. Like a chain of beads. **Monism**. Doctrine that the ultimate reality is a primordial, eternally-enduring and infinitely-extending entity (? *electricity*), of which *matter* and *energy* are two attributes. *Cf.* Dualism.

**Monkey**. Any *primate* except lemurs below and man and great apes above.

**Monobasic**. Having one replaceable H atom, or one basic hydroxyl group. **Monocarp-ic, -ous**. Bearing fruit once. Having one carpel. **Monochasium**. Sympodial inflorescence in which main axis has a single branch and each ends in a flower. **Monochlamydeous**. Having calyx but not corolla. **Apetalous**. **Monochromatism**. Having one colour (grey) vision. Colour-blindness. **Monoclinous**. With stamens and pistil on same flower. **Monocotyledon**. Flowering pl. in which first (embryonic) *leaves* are alternate, and in which, therefore, the seed-leaf or cotyledon is single; leaves are usually parallel-veined and, growth being endogenous, there are no rings in stem. *Ex.* lily. *Cf.* Dicotyledon. **Monodelphia**. Single-wombed mammals, including all those above monotremes and marsupials. Pl. with united stamens. *Cf.* Adelphous; Diadelphous. **Monœcious**. Having m. and f.

sex-organs in one individual. Hermaphrodite. *Ex.* snail.

*Fucus*. **Monogamy**. Consorting with one m. of opposite sex. *Cf.* Digamy; Polygamy. **Monogenesis**. Theory of evolution from a single entity. Direct development—*i.e.*, without metamorphosis. **Asexual reproduction**. *Cf.* Digenesis. **Monogonoporic**. With single generative orifice for m. and f. elements. *Ex.* snail. *Cf.* Digonoporic. **Monogony**. Non-sexual reproduction. **Monogyny**. Having one f. mate, or one pistil. *Cf.* Polygyny. **Monohybrid**. Hybrid offspring of parents differing in one pair of alternative characters. **Monomorphic**. Retention of one form or structure. *Cf.* Di-, Poly-morphism. **Monopetalæ**. Gamopetalæ (*q.v.*). **Monophyl-etic**. Having one common origin. **Monophyllous**. Gamophyllous (*q.v.*). **Monosepalous**. Gamosepalous (*q.v.*). **Monophyodont**. Having only one set (the milk) of teeth. *Ex.* toothed whales, whose *embryos* have two dentitions, but only one, the milk teeth, mature. **Monoploid**. Haploid. **Monopodial**. Branching acropetally from one axis. *Ex.* pine. *Cf.* Sympodial. One-footed. **Monosome**. Unpaired sex (X) chromosome (*q.v.*). **Monothalamic**. Simple-chambered. With one gynæcium. **Monothely**. Consorting with many m. Polyandry. **Monotocous**. Producing one at a birth. Uniparous. **Monotremes**. Lowest, egg-laying, mammals. *Ex.* ornithorhynchus.

**Monsoon**. A wind of S. Asia that blows N.E. Oct.—March and S.W. April—Sept.



**Moraine.** Accumulated rock-fragments deposited by glacier.

**Mordant.** A substance which, after uniting with a dye-stuff, forms an insoluble coloured compound which becomes *fixed* in a cell, tissue, fibre, or texture.

**Morphallaxis.** Regeneration (*q.v.*). Transmutation of parts. Growth of a *part* of a parent into a new individual.

**Morphine.** Alkaloid of opium ( $C_{17}H_{19}NO_3 \cdot H_2O$ ).

**Morphogenesis.** Ev. of form and structure. **Morphology.** Study of form and structure of an., pl., and rocks. Comparative anatomy. **Morphon.** See Tectology. **Morphoplasm.** Formative protoplasm. *Syn.* kinoplasm. *Cf.* Enchylema. **Morphosis.** Mode of development.

**Morula.** A mulberry-like mass of cells (blastomeres) formed during egg-segmentation. A lowly an. of this structure. Blastula.

**Mosasaurs.** Serpent-like cretaceous reptiles.

**Moss.** Bryophytes. See Alternation.

**Mother-cell.** Any cell before div. Cell with diploid nucleus. Oocyte. Spermatocyte.

**Motion, laws of.** (1) Every body persists in its state of rest or of uniform motion in a straight line unless compelled by forces to change that state. (2) Alteration of motion is proportional to the force impressed and is in the direction of the right line in which the force lies. (3) Action and reaction are equal and opposite. **Motor.** (1) A rotating machine which converts elec. into mechanical energy. (2) *Per.* nerve or

centre, or impulse subserving muscle movement.

**Moulds.** Fungi.

**Moulting.** Act of shedding worn-out feathers, analogous to the shedding of skin, scales, or hair by reptiles and mammals.

**Mousterian.** Palæolithic culture period marking the culmination of neanderthal man.

**Mouth.** Entrance to alimentary canal. Any surface aperture. Stoma. Stomodæum. Prostoma. Blastopore. Oral pole.

**Mucific.** Secreting mucus. Muciparous. **Mucilage.** Gummy material produced by pl. cell-walls and testa of seeds. **Mucin.** A glycoprotein of mucus. Muciparous. Mucific. **Mucous.** *Per.* mucus (*q.v.*). **Mucous membrane.** Lining membrane of body-passages and cavities. See Mucus. **Mucus.** Slimy, glairy, substance secreted by mucous-membrane glands.

**Mule.** Hybrid (usually sterile) of m. ass and mare. *Cf.* Hinny.

**Mullerian duct.** An egg-conveying duct present in all verts.

It is as well developed in m. embryos as in f. embryos, but in adult m. is a useless vestige and in f. becomes the oviduct.

**Multicamerate.** Multilocular. **Multicellular.** Composed of many cells. Poly-, Pluricellular. *Cf.* Unicellular. **Multilocular.** With many chambers. Multicamerate. **Multipara.** A woman who has borne more than one child. **Multiparous.** Producing more than one at a birth. *Bot.* Having many lateral axes. **Multi-**

**ple allelomorphs.** Genes produced at same locus by several different kinds of mutations. **Multipolar.** Having many extensions as in a cortical nerve-cell of grey matter.

**Muricate.** Prickled. Spined.

**Muscle.** Grouped cells highly specialized in contractile power. Flesh. *See* Cell. **Muscle sense.** Kinæsthesia. **Musculature.** The muscle system.

**Mushroom.** Edible fungus. **M. bodies.** Pair of specialized areas in insect-brain in which, probably, sensory impressions are recorded, actions co-ordinated, and acquired associations impressed.

**Musk.** Odoriferous substance from an abdominal skin-sac of m. musk-deer.

**Must.** A seasonal, raging, mating, instinct of m. elephant.

**Mutable.** Changeable. **Mutant.** Individual with characters markedly different from those of parents. **Mutation.** Suddenly-appearing variation which breeds true. Sport. Saltation. Discontinuous variation.

**Mycelium.** Network of cells forming vegetative part of fungi. Massed hyphæ. Mushroom-spawn. **Mycetophagous.** Living on fungi. Fungivorous. **Mycophagous.** **Mycetozoa.** **Myxomycetes.** **Mycophagous.** **Mycetophagous.** **Mycorrhiza.** Mycelium of fungus around tree and pl. roots. It may be symbiotic or parasitic, endotrophic or ectotrophic (*q.v.*). **Mycotrophic.** Obtaining food through help of fungi. Symbiotic.

**Myelencephalon.** Brain and spinal cord. **Myelocel.** Central canal of spinal cord. **Myelocyte.**

Nerve-cell. Giant mononuclear leucocyte. **Myeloplast.** Myelocyte. Also multinuclear giant leucocyte.

**Myocyte.** Muscle cell. Contractile cell or contractile layer of protozoan ectoplasm. *See* Myoneme. **Myoneme.** Contractile, plasmic, intracellular, fibril of protozoa, the forerunner of muscle. *See* Myocyte. **Myopia.** Near-sightedness in which rays are focused before reaching retina.

**Myriapods.** Arthropods in which body is made up of a no. of segments, each bearing one (centipedes) or two (millipedes) pairs of legs.

**Myrmecophilous.** Living as guest or parasite in ant's nest. Pollinated by ants. **Myrmecophyte.** A pl. that houses (*ex.* ox-horn acacia), or is pollinated by, ants. A pl. symbiotic with ants.

**Mysis.** Genus, also larval stage, of crustaceans.

**Myxamoeba.** Mononuclear individual myxomycete. Amœbula.

**Myxine.** The hagfish, a protandrous hermaphrodite cyclostome. **Myxobacteria.** Masses of bacilli intermediate between true bacteria and myxomycetes. *Sub.-f.* of protozoa. A mass of multinucleated protoplasm or *plasmodium* without cell-wall, with amœboid movement. They have been claimed as an. and pl. *Ex. fuligo septica*, a bright orange mass. Flowers of tan. *Syn.* myxophytes; mycetozoa; myxamoebæ; slime-mould; slime-fungi; protomyxa. **Myxopodium.** A branched pseudopodium. **Myxopterygium,** *Mixopterygium* (*q.v.*).

## N

**Nadir.** The central point of the hemisphere "below" our feet. *Opp.* zenith.

**Nanoplankton.** *Floating* sea pl. and animalcula.

**Natural.** *App.* whatever takes place in nature (*q.v.*); hence, to science, words such as "unnatural," "supernatural" are meaningless. **N. philosophy.** The physical sciences. **N. selection.** The process (independently discovered by Wallace and Darwin) whereby cert. organisms in the wild state are eliminated and cert. others allowed to survive. The differences in organisms that bring about the "fit" and "unfit" states upon which n.s. can act are due to variation.

**Nature.** (1) The "all-that-is"; the world; the universe, known and unknown. (2) The sum-total of inheritance. *Cf.* Nurture.

**Nauplius.** The first, free-swimming, larval stage of cert. crustaceans.

**Neanderthal man.** A primitive, slow-footed type of man—lacking the neck-curve of *homo sapiens*—that existed in Europe from the third inter-glacial to the end of the fourth glacial period. *Cf.* Cromagnon man.

**Neanic.** Brehpic (*q.v.*).

**Nebula.** A heavenly body consisting of vastly diffused gas or of tenuous material throughout which incandescent solid matter is distributed.

Our own solar system is a unit within a vast (probably spiral) n. known as the "galaxy" or "milky way," itself containing smaller ne-

bulae and many millions of suns. Nebulae are classified as *galactic* (within the galaxy), *ana-* or *extra-galactic* (outside the galaxy) nebulae, often called "island universes"; *diffuse* (gaseous or extremely tenuous); *planetary* (small n. with central stars); *spiral* (large nebulae similar to our galaxy); *dark*—i.e., very faint nebulae.

**Nebulium.** Ionized intra-nebular el.

**Nectar.** Honey-like secretion in nectary of flowers. **N. gland.** *Syn.* nectary (*q.v.*). **N. guides.** Markings on petals that guide insects to nectary, thus ensuring cross-fertilization. **Nectariferous.** Producing nectar. **Nectarivorous.** *App.* nectar-feeding insects and birds. **Nectary.** Organ at base of petal, usually between stamens, in which nectar is produced. *Syn.* nectar-gland.

**Negatron.** (1) Negative electron. (2) Type of thermionic valve.

**Nekton.** Minute swimming pelagic organisms near surface of seas. *Cf.* Plankton.

**Nemathelminthes.** Phylum of round worms; hookworms.

**Nematoblast.** Cell that forms the nematocyst. **Nematocalyx.** The nematocyst-bearing "guard-polyp." *Syn.* nematophore. **Nematocyst.** A hollow structure within a "thread cell" containing a hollow thread and poison-dart which can be shot out to "sting" enemies. It is formed within a cell called the cnidoblast and is present in such coelenterates as hydra and jelly-fish. *Syn.* stinging-cell. **Nematogone.** A ciliated gamete (*q.v.*) (mosses).

**Nematophore.** *Syn.* nematocalyx (*q.v.*) **Nematozooid.** A defensive zooid.

**Nemertinea.** Ribbon-worms.

**Neocene.** The tertiary geological period. **Neo-Darwinism.** The theory that, while Natural Selection is the chief factor in evolution, it operates, not on acquired characters as Darwin thought, but on genotypic variations.

**Neodymium, ch. el.** Nd. Metal. *At. no.* 60; *at. wt.* 144.270.

**Neo-encephalon.** *Syn.* telencephalon. The ant. and latest evolved part of the brain. **Neogene.** *Per.* late tertiary period. **Neo-Lamarckism.** The teaching that differences in organisms are due to inheritance of acquired characters. **Neolithic.** *Per.* later part of the Stone Age.

**Neon, ch. el.** Ne. Inert gas. *At. no.* 10; *at. wt.* 20.183.

**Neopallium.** The co-ordinating part of brain characteristic of higher primates. *Cf.* Archipallium.

An expansion of the roof of the lateral ventricle the function of which is that of "receptive organ" of the special senses—vision, hearing, and touch—to enable the individual so to blend and record these senses that, when recalled in memory, they influence his movements and behaviour.

**Neo-teinia, -teny.** Arrest of development in order to prolong an immature stage. Retention of larval characters beyond normal period. The occurrence of adult characteristics in larvæ. **Neozoic, geo.** Recent period succeeding the mesozoic.

**Nerve.** (1) One of the bundles of fibres that convey "impulses" (*q.v.*) producing motion, sensation, etc. *See*

**Neuron.** (2) The "rib" or "vein" of a leaf or of an insect wing. **N.-cell.** A neuron (*q.v.*). **N.-centre.** A collection of neurons (*q.v.*) associated with a particular function. The central part of any reflex arc—*i.e.*, the part intervening between sense-organs and motor organs. **N.-ending.** The modified terminal portion (end-plate) of a n. that receives or discharges energy. *See* Neuron. **N.-impulse.** The physico-chemical process that moves along a n. and effects a change—motion, secretion, sensation—in a muscle, gland, sense-centre, etc. The velocity of transmission of a n.i. varies with the organism; in man it is about 394 ft. per sec. *See* Impulse; Neuron.

**Nervous system.** The brain, spinal-cord, ganglia, nerves, and nerve-end-organs, upon the integration of which the acts of the individual depend. *See* Neuron.

**Neurenteric canal.** Canal in the embryo connecting the posterior ends of the spinal cord and primitive gut (archenteron). It represents the primitive mouth (blastopore) of lower invertebrates. *Cf.* Spinal canal.

**Neurocyte.** **Neuron.** A nerve-cell including its axis-cylinder and dendritic extensions. It is the unit of the nervous system (*q.v.*) which receives, discharges, and conducts nerve-impulses (*q.v.*). *See* Axon. **Neurotropism.** The attraction exercised by developed nervous tissue upon developing nervous tissue.

**Neuter, zoo.** An imperfectly developed f. A "worker." ▲

sexless organism. *Bot.* A flower destitute of stamens and pistil.

**Neutrino.** A nuclear particle with no charge and little mass. ? a positron plus electron.

**Neutron.** One of the components of an atom which is emitted during bombardment of beryllium by alpha particles. It is considered to be a proton and electron which have combined and so lost their charges. *Sym.*  $n^1$ . Mass 1.0085 (H. = 1.0081).  $1.67339 \times 10^{-24}$  gram. See Alpha-ray; Atom; Neutrino.

**Nickel, ch. el.** Ni. Metal. *At. no.* 28; *at. wt.* 58.69.

**Nictitating membrane.** *Plica semilunaris* (q.v.). A transparent membrane which can be drawn, like a curtain, across the front of the eyeball in order to clean or protect it. This so-called "third eyelid" is rudimentary in man, but is functional in birds and other lower animals.

**Nidicolæ.** *Syn. altrices* (q.v.). Birds that, when hatched, are helpless (often naked and blind) and have used up all their food-yolk, and for these several reasons must be fed for a while in a nest. *Ex.* pigeon, hawk. **Nidifugæ.** Birds that, when hatched, are able to leave their nest, run about (swim), and generally fend for themselves, for their eyes are open, they have a downy covering, and still possess a store of food-yolk. *Ex.* duck; gull. *Cf.* Nidicolæ.

**Niobium, ch. el.** Nb. *Syn.* Columbium. *Cb.* Metal. *At. no.* 41; *at. wt.* 92.91.

**Niton.** *Syn. radon* (q.v.).

**Nitrogen, ch. el.** N. Gas,  $\frac{4}{5}$  by vol. of air. *At. no.* 7; *at. wt.* 14.008.

**Nociceptive.** *App.* reflexes that protect from injuries or noxa. Also *per.* **Noci-ceptor, -receptor.** A nerve-end-organ in the skin, excitation of which arouses a sensation of pain. The other end-organs in the skin relate to feelings of touch, cold, and warmth.

**Nomogenesis.** *Ev.* considered as due to physico-chemical laws of development irrespective of environment.

**Notochord.** *Syn. chorda dorsalis.* Axial rod. The primitive vertebral column.

An elastic cartilaginous rod around which the backbone is subsequently formed in all true vertebrates. In the lowest vertebrates it lasts throughout life, but in the higher it is replaced by the vertebrae.

**Notogæa.** A zoological region—Australia and certain islands of the S. world—containing the monotremes and most marsupials. *Cf.* Arctogæa.

**Notonectal.** *App.* organisms that swim on their backs. *Ex.* water-boatmen (*hemiptera*).

**Noxa.** Stimuli that act on nociceptors (q.v.) and warn the organism of danger by evoking pain.

**Nucellus, bot.** The central and chief part of the ovule containing the embryo-sac and into which the micropyle opens. *Syn. megasporangium.*

**Nucleocentrosome.** A structure within the nucleus which acts as a centrosome during mitosis. **Nucleomicrosome.** A nucleoplasmic chromatin granule. *Cf.* Cytomicrosome. **Nucleoplasm.** *Syn. karyoplasm; linin.* The reticulated protoplasm of the nucleus. *Cf.* Cytoplasm.

**Nucleochylema.** Ground-substance of nucleus. *Syn.* karyenchyma (*q.v.*). **Nucleohyaloplasm.** The semi-fluid ground-substance of the nucleus. **Nucleolus.** *Syn.* **Nucleolus.** A small spherical deeply-staining body within the nucleus which divides during mitosis. *Syn.* chromatophere; germinal spot; karyosome; morulit; plasmosome.

**Nucleus.** (1) *Bio.* The governing, dynamic, trophic, centre of the cell essential to its life and which is halved during cell-div. The complex, spheroidal, deeply staining, mass in an. and pl. cells. *Syn.* cyto-blast, -coccus; endoplas-tule; formative centre; germinal spot; macronucleus; mesoplast; micronucleus; red granule. (2) *Ch. Phy.* The "core" of an atom consisting in the case of hydrogen of a proton, and, in the case of other atoms, of two or more protons and "fixed" electrons, *i.e.*, of protons and neutrons (*q.v.*).

**Nurture, bio.** The sum-total of environmental forces acting on an organism and furthering

its existence. Nourishment. *Cf.* Nature.

**Nutation.** (1) *Ast.* An effect consequent on the forces which cause precession not acting uniformly, so that the pole, instead of tracing out an exact circle, "nods," and thus traces out a wavy curve. (2) *Bot.* The curved motion of parts of a pl.

**Nyctanthous.** *App.* flowers that open at night.

**Nyctinasty.** *Syn.* nyctitropism (*q.v.*). **Nyctipelagic.** *App.* organisms that rise to the surface of the sea during the night and retire to the depths during the day. **Nyctitropism.** *Syn.* nyctinasty. The "sleep" movements of pl. that take place especially in the dark, such as the upward-curving of certain leaves.

**Nymph.** (1) A young insect that differs but slightly from the adult. (2) A stage following that of the larva in cert. insect metamorphoses—*e.g.*, the stage following the acquisition of 8 legs in mites. (3) Larval aquatic stage of many neuroptera such as dragon-flies.

## O

**Occam's razor.** Entities should not be multiplied unnecessarily.

**Occlusion.** (1) Closing. (2) Absorption of gases. *See* Adsorption.

**Ocelli** (Plural); **Ocellus.** (Sing.). Small eyes. Eye-like markings. Simple light-sensitive structures consisting of mere lenses sunk in skin and backed by pigment. *Syn.* eye-spot; pigment spot. Monomeniscous eye.

**Octoploidy.** Condition where no. of chromosomes is 8 times the normal (diploid) no.

**Octopods.** Sub.-O. of cephalopods. *Cf.* Decapod.

**Odontoblasts.** Cephalopods. **Odontoceti.** Toothed whales. **Odontoclasts.** Cells which absorb roots of milk-teeth. **Odontophore.** Tooth-bearing organ of cert. molluscs (*e.g.*, snail). **Odontoplast.** An odontoblast-forming cell.

**Enocytcs.** Groups of cells in insects with a probable endocrine function.

**Esophagus.** Tube through which food passes from throat to stomach. *Syn.* crop; gullet.

**Ohm.** Unit of elec. resistance. Resistance of circuit in which 1 volt produces 1 amp. **O.'s law** expresses rel. between current ( $I$ ), e.m.f. in volts ( $E$ ), and resistance ( $R$ ).  $C = E/R$ . Refers to potential difference between 2 points in conductor.

**Oleocyst.** An oil-containing bladder. *Bot.* A diverticulum of nectocalyx.

**Olfactory lobe.** Area of brain concerned in smell. *Syn.* rhinencephalon. **O. pit.** The o. organ in fishes and in embryos of higher verts. wherein it is probably homologous with the hypophysis (*q.v.*). **O. plate.** Specialized area of ectoderm lying under fore-brain of embryo on each side which becomes the O. pit. **O. vesicle.** A hollow outgrowth from fore part of embryonic cerebral vesicle which forms the smell area of the brain.

**Oligocene.** That part of tertiary period that succeeds eocene and precedes miocene. **Oligotokous.** Bearing few young.

**Omentum.** Folds of peritoneum connecting the viscera. *Syn.* epiploon.

**Ommatidium.** An el. of compound eye of insects; the beetle's eye contains 25,000 ommatidia. **Ommatophores.** Structures that carry ommatidia.

**Ontogen-esis, -y.** The before, and after, birth history of an individual. *Cf.* Phylogeny. **Ontology.** Study of the prin-

ciples and causes of being. *Cf.* Epistemology; Methodology.

**Ooblastema.\*** The fertilized ovum. **Oocyst.** Cyst formed around two conjugating gametes. An egg-containing sac. *Syn.* polysporocystid; pseudonavicella. **Oocyte.** An ovum, especially an immature one, also the cell from which an ovum arises. A f. cell preparing for conjugation. *Syn.* auxocyte. *See* Cyte; Gonia. **Oocytin.** A substance in spermatozoa which agglutinates and fertilizes ova of same species. **Oocinum.** An ovicell (*q.v.*). A brood-pouch. **Oogamete.** An oosphere (*q.v.*).

**Oogam-ous, -y.** *Per.,* or condition of producing, sexually differentiated gametes. **Oogenesis, -y.** Egg-formation. Processes by which ova arise and mature. *Syn.* megagametogenesis. **Oogonia** (Plural); **Oogonium** (Sing.), *bot.* F. reproductive organ containing oospheres (*q.v.*). Cells in which oospheres are formed or from which oocytes arise. *Syn.* mother-egg-cells; gonia. *See* Spermo-carp. **Ookinesis.** Karyokinetic stages in maturation and fertilization of ovum. *See* Mitosis. **Ookinete.** A motile oosperm (*q.v.*). **Oolemm.** Membrane around insect egg. **Oolemma.** Vitelline membrane (*q.v.*). **Oolite.** European jurassic, succeeding triassic, and preceding cretaceous. **Oophore.** An oophyte (*q.v.*). **Oophridium.** A megasporangium (*q.v.*). **Oophyte.** *Cf.* Spermophyte. The sexual generation in cert. pl. (*e.g.*, liverworts). *Syn.* oophore; gametophyte. **Ooplasm.** Cytoplasm (*q.v.*).

\* *See also* under prefix ovo (= oo).

Yolk (*q.v.*). **Oosome**. A small body inside the ovum. **Oosperm**. The fused egg and sperm. A fertilized ovum. A **zygote**. The cell that initiates a metazoon (*q.v.*). **Oosphere**. An egg-cell. An ovum before, sometimes *app.* after, fertilization. In angiosperms it arises from the micropylar cells of the megaspore; in liverworts, mosses, ferns, and cert. lycopodiums it arises from the archegonium and, after fertilization, gives rise to the oospore (*q.v.*). See Alternation of generations; Embryo-sac; Oogonia; Synergids; Germinal vesicle; Gonosphaerium; F. gamete; Megagamete. **Oospore**. A fertilized egg-cell. *Syn.* zygote. In liverworts, mosses, ferns, and conifers it arises from the oosphere, and originates the sporophyte. See Alternation of generations. **Oostegite**. Receptacle for ovum on limb of cert. crustaceans. **Oostegopod**. Limb bearing an oostegite. **Ootheca**. An egg-case. A sporangium. **Ootid**. One of the 4 parts into which an ovum divides at maturation. **Ootooid**. An an. that normally gives birth to undeveloped young. *Ex.* kangaroo. **Ootocus**. *App.* egg-laying an. **Ootype**. A shell-making gland and its duct. **Oozoid**. The "individual" ascidian arising from the ovum. *Cf.* Blastozoid.

**Opercula**. (Plural); **Operculum** (Sing.). Any lid or flap that closes an opening or plate that covers a structure. *Ex.* lid closing a snail's shell or the dwelling tube of aquatic worms; gill-cover of fishes; the movable plate in barnacles;

appendages (modified) in King Crab; plate over lung-book of spiders; membrane-bone of hyoid arch; a convolution of Island of Reil in brain; three covering-structures of foetal brain (Island of Reil); plate concealing timbal of cicadas; covering to bird's nostril. See Arches; Pre-operculum; Cere.

**Ophiuroidea**. Brittle-stars.

**Opisthocelous**. *App.* ball-and-socket jointed vertebrae when convex end of each bone is in front, and concave end behind, as in salamander and many mammals. *Cf.* Amphiprocelous.

**Optic lobes**. Parts of brain connected to retinas of the eyes which are concerned in vision. **O. thalami**. Two large ganglia of the twist-brain concerned with vision and other senses; probably "higher" centres for control of lower ones. **O. vesicles**. Outgrowth of fore-brain that gives origin to the O. nerves and retinas. See Telencephalon.

**Oral**. *Per.* mouth or region of mouth. *Cf.* Aboral.

**Order, bio.** A closely-allied group of organisms between "family" and "class." See Classification.

**Ordinate, bio.** Having rows of ornamental markings. *Math.* The distance of any point in a line measured on, or parallel to, a line called the *axis of ordinates* from a line called the *axis of abscissas* on which the corresponding abscissa of the point is measured. See *Abscissa*; *Axis*; *Co-ordinate*.

**Ordovician**. Epoch of palaeozoic era succeeding the Cambrian and preceding the Silurian.



**Organ, bio.** Any well-developed and specialized part of a living body adapted to a particular function. *See* Function; Johnston's O. O. of Corti. A modification of the ectoderm of the cochlear canal concerned in the reception of stimuli (vibrations) and their conversion into nerve-impulses which, reaching the centre for audition, evoke the sensation of sound. The o.o.c. is the inner part of the membrana basilaris of the internal ear. *Syn. organon spirale.*

**Organic.** *Per.*, or derived from, carbon compounds or living things. **Organized.** Arranged in an orderly manner. Exhibiting characteristics of an organism (*q.v.*). **Organism.** Any living entity—protist, pl., or an.

**Organogen-esis, -y.** (1) The production of an architectural plan by directive forces—*e.g.*, in the symmetrical forms of crystals, diatoms, and living things. (2) The development of organs. **Organonomy.** Laws and principles of life. **Organophyly.** Origin of organs. **Organotrophic.** Formation and growth of organs. **Orgasm.** Intense feeling, especially the sensation culminating sexual congress.

**Orientation.** The alignment of the body in a definite direction in relation to another body or source of energy. Alteration in position of organs or organisms in reaction to stimuli. *See* Tropism; Chemo-, Galvano-, Geo-, Helio-tropism.

**Ornithophil-ous, -y.** *Per.* the pollination of pl. by birds. **Ornithorynchus.** A primitive egg-laying mammal, the duck-

billed platypus. **Ornithosauria.** Extinct flying reptiles.

**Oroanal.** Serving both as mouth and anus.

**Orthogenesis.** Theory of a method of evolution in a predetermined direction through variation which produces a new type irrespective of external forces or natural selection. **Orthognathous.** *App.* head or skull when the facial angle is 85° and above. **Orthograde.** Bipedal locomotion with spinal column more or less erect as in man and higher apes. *Cf.* Pronograde.

**Orthotropous.** (1) Perpendicular growth. (2) Having chalaza, hilum, and micropyle of ovule in one straight line. *Cf.* Anatropous.

**Oscula.** The large exhalant apertures in sponges. **Osculant, -ate.** Adherent. Adjacent. Intermediate in character.

**Osmium, ch. el.** Os. Heavy metal. *At. no.* 76; *at. wt.* 191.50.

**Osmosis.** Passage of liquids and solutes through a membrane or porous material. *Cf.* Dialysis; Diffusion. *See* End-, Ex-osmosis.

**Osmotic pressure.** The force impelling the flow during osmosis.

**Osphradium.** A sense-organ—probably water-testing—in molluscs.

**Osteoblast.** A bone-constructing cell. **Osteoclast.** A bone-destroying cell. **Osteodermis.** A bony dermal plate. Ossified skin. **Osteogen.** Bone-forming tissue. **Osteogen-esis, -y.** *Per.* Bone development. **Osteoplastic.** *Per.* development of bone.

**Ostia (Plural); Ostium (Sing.)**

Pores, especially the small inhalant apertures in sponges. Any mouth-like openings—*e.g.*, that of the Fallopian tube or of crustacean heart. **Ostiole**. Any small opening. An ostium (*q.v.*). The aperture through which the conceptacle (*e.g.*, of *fucus*) discharges the reproductive cells.

**Otidium**. A molluscan otocyst (*q.v.*).

**Otoconium**. An otolith.

**Otocyst**. A vesicle or sac filled with fluid containing chalky particles called otoliths, the whole forming an organ of orientation and balance. In man it is called the utricle. *Syn.* otidium; statocyst. **Otolith**. Calcareous particle inside an otocyst. *Syn.* otoconium; statolith; lithite (*q.v.*).

**Ova**. Plural of ovum (*q.v.*). **Ovalbumin**. Chief constituent of "white of egg."

**Ovarian follicle**. Graafian follicle (*q.v.*). **Ovariole**. Ovarian tubule of insects. **Ovario-testis**. *Syn.* ovotestis (*q.v.*). **Ovary**, *zoo.* Female gonad or sex-gland wherein ova are produced—also hormones that regulate the growth, development, and activity of the sex organs. The o. corresponds to the m. gonad, spermary, or testis. The human ovary contains 10,000 to 100,000 ova out of which not more than 200 are shed. *Bot.* A floral structure—the basal part of the gynæcium (pistil) that lodges, protects and nourishes the ovule and ovum. *Syn.* germarium; germen. An o. may be: apo-, epi-, hypo-, mono-, syn-carpous; or bi-, poly-, tetra-, tri-, uni-locular. *See* Gymnoarium.

**Overtone**. A tone produced by secondary or subordinate vibrations of a wire or air-column. One of the tones (upper partials) which with the fundamental (*q.v.*) give quality or *timbre* to musical sounds.

**Ovicell**. The thickened and dilated upper part of a zoecium (*q.v.*), which lodges and protects the egg or embryo. *Syn.* oecium; brood-pouch.

**Oviduct**. The tube through which ova pass to exterior. *See* Mesovarium. *Syn.* gonoduct; Mullerian duct. **Ovigerous legs**. Appendages of certain marine m. organisms (*Pycnogonida*) on which are lodged the eggs. **Oviparity**. Condition of producing eggs that may mature and become fertilized inside or outside but which are hatched outside the mother's body. *Cf.* Viviparity; ovoviviparity. **Ovipositor**. An egg-depositing organ. A transformed pair of limbs in bees and wasps. A sting is a modified ovipositor. In f. fishes the ovipositor is a tubular extension of the genital orifice. *See* Hypopygium. **Ovisac**. An egg-capsule or receptacle.

**Ovosporangia**.\* Sporangia that produce ova. *Cf.* spermosporangium. **Ovotestis**. A gonad which produces m. and f. gametes. The ova- and sperm-producing organs of cert. hermaphrodite molluscs—*e.g.*, snail. *Syn.* ovario-testis; hermaphrodite gland. **Ovoviviparity**. Condition in which eggs may hatch inside or outside the mother—*i.e.*, in which the mother both lays

\* *See also* under prefix oo (= ovo).

eggs and brings forth young alive. Cf. Oviparity.

**Ovule.** An ovum, especially that of pl. More strictly it is a many-celled structure which contains the ovum, egg, or f. gamete. The precursor of a seed. A seed-bud. The immature "seed" of a flowering pl.

The o. is attached by a short stalk to the carpel and arises from the placenta (*q.v.*); it contains a narrow opening, the micropyle, leading towards the ovum. In pinus the o. arises from the sporophyte, produces the embryo-sac, and is homologous with the megasporium of pteridophytes (ferns, etc.). *Syn.* megasporangium; nucellus; oosphere; seed-bud; synergids. *See* Anacampylo-, Orthotropous o. *See* Cauline; Foliar; Male; Funiculus; Micropyle; Nucellus; Synergids.

**Ovum.** Plural ova. An egg. The f. gamete, sex-cell, or germ.

The f. el. out of which, after fertilization by the m. el., grows an individual. The fertilized o. is called a zygote or protoblast, the unfertilized a megagamete. The spermatogonium is the homologue of an unfertilized o. As a rule the o. is very much larger and better nourished than the sperm cell of the m. The diameter of a human o. is about 1/250 inch, and there is little difference in

size in all mammalian eggs, that of a mouse and of a whale being practically the same. The o. of primitive mammals such as ornithorynchus and echidna is about 50 times larger—i.e., 1/4 inch in diameter—than the human o.

*Syn.* ooblastema; oocyte; oosphere; protoblast; megagamete; egg. *See under* Graafian follicle; Embryo-sac; Alecithal; Demersal; Brood; Holoblastic; Meroblastic; Pseud-, Primordial-ova.

**Oxygen, ch. el. O.** A gas composing about 20.95 p.c. by volume, or 23.12 p.c. by wt., of air, and 33.3 p.c. by vol., or 88.8 p.c. by wt., of water. *At. no.* 8; *at. wt.* 16.000. **Oxygnathous.** Having tapering jaws. **Oxyntic cells.** Acid-secreting cells—e.g., the hydrochloric acid forming cells of stomach. **Oxyphil-ic, -ism, -ous.** *App.*, or condition of, cells that readily take up acid stains. *Syn.* eosinophilic. **Oxytrop-ic, -ism.** *Per.* tendency of organisms to be attracted towards a source, or higher concentration, of oxygen.

**Ozone.** *Syn.* O<sub>3</sub>. An allotropic form of oxygen.

## P

**Pachyderms.** Thick-skinned mammals. **Pachynema.**

**Pachytene** (*q.v.*) chromatin threads. **Pachytene.** (1) Double thread produced by pairing chromosomes during prophase of meiosis. (2) Stage following syndesis when chromatin threads, as pachynemas, are shortened and thickened.

**Pacinian corpuscles.** Nerve network surrounding nucleated

cells in skin of hands and feet. Touch-bodies.

**Pädogamy.** *Autogamy* in which gametes are formed after many nuclear divs. **Pädogenesis.** Parthenogenetic production of offspring by immature (larval) females. *Ex. cert. flies; gall midges.*

**Pain.** Sensation aroused by stimuli which have injured cells. *Psychical adjunct of a protective reflex.*

**Palaeartic.** Europe, North Asia, Africa, and Arabia. **Palaeocephalon.** Primitive brain; represented in the human brain by the lower centres and ganglia. **Palaeogæa.** Eastern hemisphere. **Palæogene.** Early tertiary. **Palæogenetic.** Persistence of characteristics normally embryonic only. **Atavistic.** **Palæolaurentian.** Archaeozoic (q.v.). **Palæolithic.** Early human culture period characterized by use of rough flint instruments. **Middle Stone Age** = eo-, *palæo*-, and *neo-lithic*. It includes: pre-chellean, chellean, acheulean, mousterian, aurignacian, solutrean, magdalenian, and azilian. Duration 500,000 to 1,500,000 years. **Palæomastodon.** Primitive oligocene elephant. **Palæontology.** Science of fossils. **Palæobotany** and **palæozoology.** **Palæozoic.** Earliest Cambrian to end of Permian. **Fish-amphibian age.** **Palæozoology.** Div. of palæontology (q.v.).

**Palate.** Roof of mouth and hinder suspended fold. **Epi-pharynx.** Projection in cert. corollas. **Palea.** Scaly bract; palet; ramentum. Cf. Glume.

**Palingenesis.** Reappearance of ancestral characters with correct maintenance of phylogenetic record. Cf. Cæno-, Tachy-genesis.

**Palisade.** Cylindrical cells, rich in chloroplasts, with small intercellular spaces, beneath cuticle and epidermis of upper surface of leaf.

**Palladium, ch. el.** Pd. Metal. *At. no.* 46; *at. wt.* 106.70.

**Pallium.** Cerebral cortex

which covers rest of brain like a *cloak*. *Archi*-, and *neo-pallium* (q.v.). Mantle of molluscs, brachiopods, etc.

**Palmate.** *App.* leaf div. into radiating lobes, or to feet with front toes webbed. **Palmella.** F.-w. alga especially when existing as groups of spherical cells united into a jelly-like mass from which, when conditions are more favourable, single cells develop cilia and swim off independently.

**Palmitin.** Glycerol tripalmitate, a crystalline fat in an. and pl.

**Palp.** A sensory, also sexual, organ. **Feeler.** **Tentacle.** **Pedipalp.** A sensory structure on maxillary appendages of myriapods and other arthropods, and in prostomium of worms. **Sexual organ** on "tarsus" of m. spiders within which sperm cells are stored and subsequently ejected by the hæmatodochæ into genital orifice of f. **Palpacle.** **Tentacle** of dactylozooids and siphonophores. **Palpi-fer, -ger.** Lobe of maxilla supporting palp. **Prementum.** **Palpocil.** Sensory filament of hydromedusæ. **Palpon.** Dactylozooid. **Gonostyle.**

**Paludal.** *Per.* marshes.

**Pancreas.** An abdominal digestive gland with endo- and exo-crine functions. In response to *secretin*, elaborated from *pro-secretin* of duodenum, it liberates *insulin* which controls conversion of glucose to glycogen. In virtue of its enzymes—e.g., lipase, trypsin, amyllopsin—it "digests" food-substances. *Syn.* sweetbread.

**Pandemic.** Large-scale epi-

**demic.** **Pangamic.** Indiscriminate mating within a species. **Pangen.** Hypothetical, supramolecular unit of germ-plasm and somato-plasm. **Biophore.** Gemm-a, -ule. **Idioblast.** Micella. **Plasmas.** **Pangenesis.** Theory (abandoned) that *pangens*, thrown off from the body-cells, and stored in the germ-cells are the bearers of hereditary traits. **Panicle.** Compound racemose inflorescence with branched pedicels. **Pannerism.** Assumption that cert. protoplasmic fundamentals are adaptable into any type of tissue. **Panmixia.** Indiscriminate breeding resulting from a supposed cessation of Natural Selection; also the process by which organs when no longer useful disappear. **Panphotometry.** Condition whereby leaves orientate themselves to avoid excess sunlight.

**Papilla.** Any nipple-like process. One of the small conical projections on surface of tongue. **Pappose.** Hairy. **Feathery.** **Pappus.** Modified, feathery, calyx which "balloons" a seed (e.g., dandelion) to a distance. **Papule.** Raised, localized area of skin or mucous membrane.

**Parabiosis.** Condition wherein cells or organisms are but partially conjoined. Reversible suspension of vitality (*app.* rotifers; nerves). **Parablast.** An accessory embryo. Large nucleated yolk-cells. **Mesoblast.** **Parabola.** Plane curve every point of which is equidistant from a fixed focus and a fixed straight line, the directrix. **Parachromatin.** Linin (*q.v.*). See Chromatin. **Paracme.** De-

cline, senescence, or decadence of the individual or race.

**Paraderm.** Covering of pro-nymph; entoderm. **Paradesm-ose, -us.** Secondary connection between extra-nuclear centrioles in mitosis. **Paradi-dymis.** See Paroöphoron. **Paraffin.** Hydrocarbon,  $C_nH_{2n+2}$ , of methane series.

**Paragenesis.** Mutual effect of contact on development of minerals. *App.* hybrid that is fertile with parent, but infertile with another hybrid. **Paraheliotropism.** Turning of pl. leaf into a plane parallel with sun's rays so that light reception is lessened. **Paralinin.** Nuclear ground-substance. See Linin.

**Parallax.** Apparent displacement of object due to actual displacement of observer. **Parallax angle.** Angle whose apex is at centre of object and whose sides pass through two points of observation. *P., solar.* 8-803 secs.

**Parallelepiped.** Six-sided prism with each face a parallelogram.

**Parallelogram.** Quadrilateral fig. with *opp.* sides parallel.

**Paramagnetic.** Magnetic.

**Magnetizable.** *Opp.* diamagnetic. **Paramere.** Either half of a bilaterally-symmetrical organism. A paired organ.

*Ex.* kidney. **Paramitome.** Interfibrillar substance of protoplasm. *Cf.* Mitome.

**Paramœcium.** The "slipper-animalcule," a ciliated infusorian.

**Para-nuclein, -nucleus.** Accessory nuclein (*q.v.*) or nucleus (*q.v.*). Substance of nucleolus, or plasmosome. **Mitosome.**

**Micronucleus.** An aggregate of mitochondria. *App.* many cytoplasmic structures, and to nucleins derived from cyto-

**plasm.** Prochromatin; pyrenin; pyrenocarp. **Paraphyses.** Barren hyphae which in m. cryptogams surround antheridium, in f. cryptogams the archegonium. *Cf.* Spermatia. **Paraphysis.** Median evagination on top of brain of lower verts. *Cf.* Hypophysis. **Parapineal.** Eye-like homologue (in lamprey) of higher vert. pineal body. **Paraplast.** Less active, more vegetative, part of cytoplasm. Sometimes *id. c. meta-, ex-plasm* and "ground-substance." **Parapodia.** Paired lateral outgrowths functioning as limbs in cert. worms. Lateral edges of molluscan foot. **Para-site, -sitism.** *Per.* an organism that nourishes or shelters itself at expense of another organism without contributing any beneficial return. An organism, pl. or an., which invades and consumes the tissues of another organism or *host*. One half the an. kingdom are parasites, the other half, hosts. *See* Ecto-, Endo-, Epi-parasite; Facultative; Trophobiont, -biosis; Inquiline; Guest; Symphiles; Synoeketes; Synecthrans; Myrmeco-, Termitophilous; Symbiont; Symbiosis; Commensalism. **Parasitic castration.** Emasculation of m. crabs by the parasite *sacculina* (*q.v.*). **P. males.** Pigmy m. parasitic on the f. of cert. barnacles; they exist in all states of degeneration, from loss of limbs, alimentary canal, etc., to loss of practically the whole body except the testes. **Parasynapsis, -syndesis.** Conjugation lengthwise of homologous chromosomes. *Cf.* Telosynapsis. **Parathyroids.** Four ac-

cessory thyroid glands whose hormones regulate amount of calcium in the body.

**Pareiasaurus.** Permian reptile of S. Africa; it had a large pineal body. **Parencephalon.** Cerebellum. **Parenchyma.** Soft, succulent, tissue of pl. formed of cells rich in protoplasm. Ground-substance. *Cf.* Prosenchyma. Endoplasm of protozoa and sponges. **Parenchymula.** Larva of sponge. **Parietal.** *Per.* wall, or its lining. Bone of skull. **P. eye.** Pineal body.

**Par-œcious, -oicous.** Having antheridium and archegonium close together on one branch. **Heterœcious.** **Paro-öphoron.** Remnant of *mesonephros* (*q.v.*), the embryonic renal organ [Wolffian tubules (*q.v.*) between ovary and uterus. **Parovarium.** It corresponds with m. paradidymis. **Parotid.** Salivary gland in cheek. **Parovarium.** Epo-, **Paro-öphoron** (*q.v.*). **Parsec, ast.** Unit of length. Distance covered by light-ray in 3.26 years. Approx.  $19 \times 10^{12}$  miles or 206,265 times semi-major axis of earth. **Parthenogenesis.** Development of unfertilized ovum. A degenerative form of reproduction of new individuals by a f. without m. intervention.

Segmentation and development of *asexually fertilized* ova which occurs normally in hymenoptera and may be artificially produced by physicochemical stimuli in echinodermata and other an. as high as frogs. In rotifers fertilization is unknown and in some genera m. have never been seen. In some crustaceans m. appear only seasonally. In aphides m. may be absent for several years. Drones are produced from unfertilized eggs. In stonewort m. organs sometimes disappear, yet the pl. continues to multiply; in fact, all stages are repre-

sented in pl.; thus, in *pythium* there is complete fertilization of f. by m.; in *phytophthora* only a few m. cells ever reach the f., while in *peronospora* no m. cells reach the f. pl. In cert. *saprolegnias* the antheridia are near and directed towards f. organ, yet latter never opens; in other *saprolegnias* the m. organs do not get near the f. ones, and in yet others there are no m. organs, yet the f. cells develop. In lowly algae, m. *parthenogenesis* occurs—i.e., a small m. cell, which normally unites with a f. cell, develops by itself. Thus we see that a m. mother-sperm-cell, a f. mother-egg-cell, a m. gamete, and a f. gamete, each have power of parthenogenetic development. m. p. is apomixis in which m. nucleus becomes the embryo. *Diploid p.* is apomixis in which meiosis fails first, while *haploid p.* is apomixis in which fertilization fails first. A parthenogenetic egg produces one polar body only, not two as in normal ovum. This polar body appears to act as a sperm-cell. On this view p. is not strictly asexual but is a kind of *intracellular fertilization*. Occasionally an ovum (e.g., in frog, hen, and even in mammal) starts to develop without any sperm stimulus; this is known as *pathological p.* In *juvenile p.* there is a precocious production by larvæ of parthenogenetic ova and the development from these of offspring. *Ex.* the ova within larvæ of cert. midges (*anastor*) develop, within the mother-larva, into daughter-larvæ which feed on the mother-larva, thus killing her. These daughter-larvæ, starting life on their own, produce larvæ parthenogenetically within their own bodies and are themselves consumed. This process goes on for many generations, the ova getting smaller and smaller, until at length parthenogenesis ceases, the larvæ produce normal m. and f. flies, and the latter lay normal eggs fertilized by the males. See Arrhenio, Deutero-, and Thelyo-toky; Polar Bodies; Pseudova. *Syn.* aspermic development; agamy; agamo-, paedogenesis.

**Parthenogonidium.** Zooid capable of asexually producing another colony. **Parthensperm.** AzygospERM (q.v.).

**Parturient, -ition.** Bringing forth young.

**Pascal's law.** A fluid under

p. exerts equal p. upon equal areas of surface.

**Patagium.** (1) Parachute-like fold of skin for purposes of flight in cert. an.—e.g., bat, pterodactyl. (2) Process on each side of prothorax of butterflies, etc.

**Patella.** (1) Knee-cap. (2) Leg joint in arachnids. (3) Apothecium (q.v.).

**Pathogenic.** Disease-causing. **Pathology.** Study of diseases—*etiology*, *nosology*, *teratology*.

**Patroclin-al, -ous.** Inheritance in which offspring resemble their m. more closely than their f. parent. *Opp.* matriclinal. **Patrogenesis.** Exclusive derivation of chromatin in zygote from m. gamete. **Patrogony.** Modification, by adaptation, of normal embryonic development. *Cf.* Armogony.

**Paulospore.** Spore in "resting," or suspended development, stage. Bud. Cyst. Chlamydospore.

**Pearl.** A pathological growth consisting of thin layers of nacre (mother-of-pearl) around a nucleus of foreign matter in bivalve molluscs.

**Pecten.** Any comb-like organ. Row of spines on a palp or chelicera. Stridulating organ. Sterigma. Part of reptilian eye or of eye-socket in birds. A mollusc (scallop).

**Pectoral.** *Per.* chest or breast.

**Pedical.** Stalk of leaf, flower, fruit, sporangium, etc. Ultimate div. of peduncle. Second joint of antenna. **Pedicellaria.** Minute scissor-like organs (modified spines) on aboral surface of echinoderms. **Pedi-**

**culus.** Louse. Mite. **Pedipalp.** Six-jointed, leg-like "feeler" of spiders, etc., for seizing prey. **Peduncle.** Stalk of flower. Any stalk-like structure—e.g., that fixing brachipods and other an. to a support. Junction of thorax and abdomen in wasps, ants, etc. Nerve-structure in brain.

**Pelage.** Woolly or hairy covering. **Pelagic.** *Per.* open sea, or to organisms dwelling near its surface—i.e., in zone of light-penetration. *Plankton plus nekton (q.v.).* **Pelagic.** Wandering.

**Pelecypoda.** Bivalve molluscs. Lamellibranchs. *Ex.* oyster.

**Pellate.** To repel or move apart. *Opp.* tractate.

**Pelta.** Shield-shaped apothecium (*q.v.*).

**Pelvis.** (1) Bony basin formed by sacrum, coccyx, and innominate bones. (2) Ureter expansion at kidney. (3) Basal part of crinoid cup.

**Pendulum.** A suspended bob swinging to and fro under action of g. and a weight—or spring-imparted momentum. The seconds pendulum is 39.1398 ins. from point of support to centre of gr. of bob at Greenwich Lat.

**Penicillate.** Tipped with hairs. Paint-brush-like. **Penis.** M. intromittent organ homologous with clitoris in f. phallus. **Edeagus.** **Penn-aceous.** -iform. Feather-like.

**Pennsylvanian, geo.** Upper carboniferous.

**Pentacyclic.** Five-whorled. *Cf.* Pentamerous. **Pentadelphous.** Having five clusters of filament-united stamens. **Pentagon.** Five-angled, five-

sided polygon. **Pentagynous.** With five styles. *Cf.* Pentandrous. **Pentamerous.** Having five divs. in whorls, or multiples of five. *Cf.* Pentacyclic. In five parts. **Pentandrous.** With five stamens. *Cf.* Pentagynous. **Pentaploidy.** Having five times as many chromosomes as basic haploid no. **Pentarch.** Having five alternating xylem and phloem groups. **Pentastichous.** *App.* leaves arranged in five vertical rows.

**Penumbra.** Semi-dark space between umbra (dark shadow) and fully-lit part. Shaded area around umbra of sunspot.

**Pepo.** Many-seeded pulpy fruit.

**Pepsin.** Proteolytic enzyme (protease) in gastric juice of stomach. It converts proteins to peptones. Present also in pl. **Peptide.** Hydrolyzed protein—a combination of amino-acids. **Peptones.** Albuminoids formed by hydrolysis of proteins.

**Perception.** Act or process of knowing an object by means of sense-impressions or *percepts* derived from sense-organs.

*Ex.* seeing a book, and knowing it as a book = *perception*; thinking of a previously-seen, but not presently-seen, book is *imagination* or *ideation*; mistaking a bottle on the table (in, say, dim light) for a book is *illusion* (*q.v.*); seeing a book on the table when there is nothing there is *hallucination*; seeing something on the table with inability to state its nature is *imperception*; seeing a bottle on the table and believing it to be a spirit is a *delusion* (*q.v.*). *Hallucination* is thus a false sense-impression; *illusion* is self-deception from false interpretation of a sensation, while *delusion* is self-deception through false belief.

**Percnosome.** Granule within an androcyte (*q.v.*).



**Pereiopods.** Locomotory thoracic limbs. *Cf.* Pleiopods. **Perennibranchiates.** *App.* amphibia having persistent gills. **Perianth.** Floral envelope. Outer flower parts when not distinguishable into calyx and corolla. *See* Lodicule; Perigonium, -gynium. **Periblast.** Derivative of *protoblast* (*q.v.*), which gives rise to ecto- and endo-blast. Epiblast or blastoderm of insect embryo. **Periblem.** Cell-layer between dermatogen and plerome. **Pericardium.** Serous membrane surrounding heart. **Pericarp.** Modified walls—epi-, meso-, endo-carp—of pl. ovary. *See* Fruit. **Pericycle.** Tissue between bast and endodermis surrounding vascular bundles. External layer of stele. **Periderm.** Cortical tissue of outer bark. *Phelloderm plus cork.* **Phellogen** and its offspring-tissues. External cuticular layer of hydrozoa. **Peridesm.** Tissue around vascular bundles in astelic stems. **Peridium.** Outer coat of sporophore. **Perigee.** Point in orbit of revolving body that is nearest centre of attracting body. *Apsis.* *Opp.* apogee. **Perigonium.** Sac in gonophore enclosing generative bodies. **Perianth** (*q.v.*). Cluster of bracts or involucre surrounding antheridia. **Gonotheca.** **Perigynium.** Structure surrounding archegonium (or sporophyte). Marsupium of liverworts. Membranous perianth (*q.v.*) of mosses. **Perigynous.** Having stamens, sepals, or petals inserted into receptacle surrounding the gynoecium (pistil). *See* Corolla; Flower. **Perihelion.** That part of

planet's orbit nearest sun. (Position reached by earth c. Jan. 1.) *Opp.* aphelion. **Perilymph.** Fluid surrounding membranous labyrinth of ear. **Perineum.** Zone between anus and genitals. **Perinium.** Microspore envelope. **Periodic table.** An arrangement of ch. els. in ascending order of *at. nos.* and in which els. of similar ch. properties appear periodically and fall into definite groups. **Periodicity.** Frequency (*q.v.*). **Periophthalmus.** Mud-hopper. A teleost. **Periosteum.** A membrane investing and nourishing bones. **Peripatus.** An arthropod (protracheate) linking insects and worms. **Periplasm.** Outer zone of oogonium of fungi which surrounds ovum. Tapetal cells in sporangium of ferns which nourish the spores. *Cf.* Centropiasm. **Perioplast.** Peripheral, extranuclear, protoplasm. Inter-cellular substance. Attraction-sphere. Cell-wall. Centrosome. Ecto-, Cyto-plasm. **Peripneustic.** Having stigmata in two rows, one along each side of body, as in insect larvæ. *Cf.* Amphio-, Meta-pneustic. **Periproct.** Area around anus. *Opp.* peristome. **Perisarc.** Horny covering of hydrosome. *See* Hydrotheca. **Periscope.** Optical instrument enabling observer to obtain a view otherwise precluded by an obstacle. **Perisome.** Body-wall. Integument. **Perisperm.** Substance around sperm-cell or embryo-sac. *Opp.* endosperm. **Perisphere.** Outer region of attraction-sphere. **Plasmosphere.** *Opp.* centrosphere (*q.v.*). **Perispore.** Spore-coat. Spore mother-cell. **Perissad.** *Ch. el.* of un-

even valency. *Cf.* Artiad. **Perissodactyls.** Odd-toed ungulates in which middle digits are pre-eminent. *Ex.* horse. *Cf.* Artiodactyl. **Peristalsis.** Wave-like movement of gut while forcing its contents onwards. **Peristome.** Region around mouth. *Cf.* Periproct. Toothed fringe around capsular orifice of mosses. **Perithecium.** Asco-, pyreno-carp. **Peritoneum.** Serous membrane lining abdominal body-wall, body-cavity, and viscera. **Peritrochium.** (1) Ring of cilia. (2) A larva invested with a ring of cilia.

**Perm.** One maxwell per ampere turn. **Permeance.** Reciprocal of magnetic reluctance (*q.v.*). **Permian, geo.** Period between Carboniferous and Triassic periods.

**Peronate.** Woolly. **Powdery.** Covered with a "bloom." **Peroxide.** An oxide relatively rich in O, or one in which O is joined to O as in  $H_2O_2$ , peroxide of hydrogen. **Personal equation.** Constant deviation from a correct result due to personal qualities in the observer. **Personate.** *App.* two-lipped corolla in which throat is nearly closed by a projection from base of lower lip. *Ex.* snap-dragon. **Perula.** Scale of leaf-bud. **Mentum.**

**Petal.** One of the modified leaves forming corolla of flower. **Petalody.** Conversion of flower parts, stamens, etc., into petals. **Double-flower formation.** *Syn.* calycanthemy. **Petiole.** (1) Leaf-stalk. *See* Phyllode. (2) Stalk connecting alitrunk and abdomen in hymenoptera. **Mesopodium.**

**Petri-faction, -fication.** Fos-

silization in which original organic material of organisms has become mineralized (silicified) and changed into stone. **Petrogenic.** *Per.* origin and formation of rocks. **Petroleum.** Mixture of hydrocarbons in upper strata of earth.

**Phæochrome.** Chromophil. **Phæophyceæ.** Brown seaweeds. **Phæophyll.** Pigments of *fucus*: chlorophyll, carotin, fucoxanthin, xanthophyll. **Phæoplasts.** Brown chromatophores. **Phæospores.** Spores containing phæoplasts.

**Phagocyte.** An amœboid cell which "devours" other cells and foreign bodies. A protective, bacteria-destroying agent. *Cf.* Leucocyte. **Odontoclast.** **Planocyte.** **Phagocytosis.** Destruction of bacteria by phagocytes. **Phagolysis.** Dissolution of phagocytes.

**Phalan-ge, -x.** (1) Finger; (2) toe; (3) bone of digit; (4) bundle of united stamens.

**Phallus.** Penis or clitoris.

**Phanerocononic.** *App.* hydroid colony that reproduces by detaching free-swimming gonophore-bearing medusomes. *Cf.* Adelocodonic. **Phanergam.** Pl. with conspicuous pistil- and stamen-bearing flowers. **Spermatophyta.** Angio- and gymno-sperms. *Cf.* Cryptogam.

**Pharynx.** Musculo-cutaneous tube connecting mouth (and nose) with gullet and windpipe.

**Phellem.** Cork. **Phello-derm.** Secondary parenchymatous cortex on inner side of cork cambium; it is derived from phellogen. Inner tissue of periderm. **Phellogen.** Cork-cambium layer of cortex. It

arises as a secondary meristem (*q.v.*) and forms externally the cork and phelloderm. The phellogen and tissues it forms represent the *periderm*.

**Phenacetin.** Sedative antipyretic.  $C_{10}H_{13}NO_2$ . **Phenol.** Phenyl alcohol or pure crystalline carbolic acid.  $C_6H_5O$ .

**Phenomenon.** An event or object perceived by the senses. *See* Vital P. **Phenotype.** Group of individuals similar in appearance but dissimilar in genetical constitution. Type group. The *external* appearance produced by reaction of an organism of given genotype (*q.v.*) with a given environment.

**Philothionic.** *App.* micro-organisms that use energy of sulphur-compounds to construct organic carbon compounds. Sulphophilous.

**Phloem.** Soft bast. Outer part of vascular bundles of monocotyledons. It consists of sieve-tube tissue and conveys elaborated foodstuffs down the stem from the leaves. Leptone. *Cf.* Xylem.

**Phototaxis.** Reflex "avoiding" reaction.

**Phon.** Unit of loudness. *See* Bel. **Phonation.** Sound-production by living organisms; mechanical production of speech-sounds.

**Phoranthium.** Receptacle of compositæ. Clinanthium.

**Phorozoids.** Free-swimming foster-zooids of sexual generation of cert. tunicates which, though they give rise to gonozoids (*q.v.*) never themselves attain sexual maturity. *See* Alternation. **Phorozoon.** An organism that has not attained sexuality. A larva.

**Phosgene.** Colourless "poi-

son gas" causing intense respiratory irritation.  $COCl_2$ . **Phosphene.** A light-impression due to stimuli other than light-waves. **Phosphorescence.** Emission of light without sensible heat as a result of previously-absorbed radiations. Very slow oxidation. "Cold light." *Cf.* Fluorescence; Luminescence. (*See* S.L.)

**Phosphorus, ch. el.** P. Non-metal. *At. no.* 15; *at. wt.* 31.02. Five allotropes.

**Photobiotic.** Needing light to live. **Photoelectric.** *Per.* emission of electrons under action of light. Also to devices for transforming varying intensities of light-vibrations into varying intensities of electric current. **Photogen.** Light-producing organ—*e.g.*, that in glow-worm. **Photogenin.** A colloid which emits "cold" light when oxidized through influence of photophelein (*q.v.*). **Photokinesis.** Light-induced movements—*e.g.*, butterflies are *photokinetic*. **Photokinetic.** *Per.* photokinesis.

**Photon.** (1) Unit of light-intensity; unit on a sq. mm. of pupillary area from a light-source = one candle per sq. metre. (2) Light-quantum; a free-travelling, particle-like quantum of radiation.

A p. has *inertia* or *mass* and, being always in motion, *momentum*. The momentum of a p. when colliding with matter (*e.g.*, when an X-ray meets an electron) is = the energy quantum of the p. div. by the vel. of light. *All* radiations consist of photons, and these, while able to react with matter, are unable to do so with one another—only matter can arrest or deflect them. An average wireless wave is a p. of 1640 ft. w.-l.,  $10^{23}$  of them leaving the transmitter per sec. All p. have the same

vel. (180,220 miles per sec.) irrespective of the vel. and direction of movement of the body ejecting them. When, in a *system of photons*, each unit has same length, the system as a whole exhibits *wave-properties*. This is the basic idea of wave-mechanics. De Broglie and Schrodinger think that "matter" and "energy" may, at bottom, prove to be identical—electrons, protons, and photons, being all "radiation quanta," all "particles" of energy. Yet each of these is surrounded by a *wave-system* of fre-

quency  $\frac{w}{h}$ , where  $w$  = energy, and  $h$  = Planck's constant ( $6.624 \times 10^{-27}$ ) which travels along with it, the whole forming a "wave-particle." See Light; Wave; Matter; Radiation.

**Photorasty.** Orientation to diffuse light. **Photopathy.** Response to light-stimuli. **Phototaxis.** **Photophelein.** A substance which stimulates oxidation of photogenin (*q.v.*) (by disintegrating it and multiplying its surface) and so figures in phosphorescence of organisms such as firefly. **Photophily.** Movement towards, or thriving in, light. **Photophobia.** Shunning the light. **Photophore.** Phosphorescent organ. **Photophoresis.** Radiation pressure. Movement of minute particles under influence of radiant energy. **Photophygy.** Avoiding strong light. **Shade-loving.** **Photoreceptor.** Terminal organ—*e.g.*, retina—specialized for receiving light-stimuli. **Photosphere.** The bright, hot ( $t = 5800^\circ \text{C.}$ ) envelope of metallic vapours surrounding the sun and surrounded by the reversing layer and chromosphere. **Photosynthesis.** Process by which *chlorophyll* (*q.v.*) constructs higher chemical compounds (sugars, etc.) from simpler ones ( $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ) under influence of sunlight. Carbon

assimilation. See Synthesis.

**Phototaxis.** Movement of organisms towards (positive), or away from (negative), a light-source. Orientation to light. *Ex.* a shoot is positively, a root or a blow-fly maggot is negatively, phototactic. **Phototropism.** **Photopathy.** **Phototonus.** Light-sensitivity.

**Phototropism.** One-sided response to light-stimulus. Turning in the *direction* of light-rays, as of sunflower towards or of tendril away from sun. **Heliotropism.** **Phototaxis.** When movement is between these extremes, as when a leaf turns itself edgewise to sun, the condition is termed *diaphototropism*.

**Phragma.** An inwardly-projecting partition. False dissepiment in pl. ovary. Apodeme. **Phragmoecone.** Chambered sac or shell.

**Phrenic.** *Per.* diaphragm.

**Phthisis.** Pulmonary tuberculosis.

**Phycochrome.** Colouring matter of blue-green algae (*chlorophyll plus phycocyanin*). **Phycocyanin.** Pigment of cyanophyceae. **Phycoerythrin.** Pigment of red seaweeds. **Phycomycetes.** Alga-like fungi. **Moulds.** **Mildews.** **Phycophaein.** Brown sea-weed pigment. **Phycoxanthin.** Yellow pigment of diatoms.

**Phylactocarp.** Modification of hydrocladium for protection of gonophore. **Corbula.** **Phyletic.** *Per.* race.

**Phyllade.** Reduced scale-like leaf. **Phylloclade.** Flattened stem functioning as leaf. *Ex.* cactus. *Syn.* cladode. **Phyllocyst.** Rudimentary cavity of hydrophyllium. **Phyl-**

lode. Leaf-like petiole, or flattened leaf-stalk, functioning as a leaf. **Phyllody**. Modification of part of a flower into a leaf. **Phylломорфosis**. Leaf-variation at different seasons. **Phylogeny**. Leaf development. **Phyllophore**. Leaf support. Terminal bud of palm. **Phyllopod**. Crustacean with leaf-like swimming feet. **Phyllopodium**. Leaf-axis. A sheathing leaf—e.g., around sporangium. **Phylloptosis**. Leaf-shedding. **Phyllotaxis**. Leaf arrangement. **Phyllloxanthin**. Xanthophyll.

**Phyloephebic**. Racial stage corresponding to individual adolescence. **Phyloneanic**. Cf. **Phylo-gerontic**, -**nepionic**. **Phylogenesis**. Ancestral evolution. Ancient development of the race. Cf. **Auto-**, **Onto-**genesis. **Phylogerontic**. Stage in life-history of race corresponding to individual senescence. Cf. **Phyloephebic**. **Phyloneanic**. **Phyloephebic**. **Phylonepionic**. Stage in life-history of race corresponding to infancy of individual. Cf. **Phyloephebic**.

**Phylum**. Sub-kingdom. A main div. in biological classification.

**Physics**. Science of matter and energy. **Physiogenesis**. Origin of function. Development of vital activities. Cf. **Plasmogeny**. **Physiography**. Study of Nature. **Physiology**. Science of functions of organisms. Cf. **Bionomics**.

**Physoclistous**. Having air-bladder disconnected from gut. Cf. **Physostomous**. **Physogastry**. Degraded state among "guests" of ants and termites and in the "queens" themselves, wherein wings and eyes,

etc., degenerate, and abdomen becomes enormously distended with fat. **Physostomous**. Having a duct connecting intestine and air-bladder. Cf. **Physoclistous**.

**Phytogenesis**. Plant evolution. **Phytoma**. Vegetative substance of pl. cell. **Phytomer**. **Phyton**. Pl. fundamental. Smallest unit of a pl. that can grow into new individual. **Phyto-phagous**, -**philous**. Feeding on pl. Herbivorous. **Phytoplankton**. Pl. plankton (*q.v.*), diatoms, etc. **Phytoplasm**. Pl. protoplasm. Cf. **Zooplasm**.

**Pigment**. **Hæmoglobin** gives red colour to blood of verts.; **hæmocyannin**, blue colour to blood of worms, molluscs, etc.; **chlorophyll**, green colour to plants; **xanthin**, yellow colour to flowers; **erythrin**, red colour to seaweeds.

Rapid change of colour is due to activation of **chromatophores** or pigment-cells (e.g., chameleon). See **Albinism**; **Erythrin**; **Etiolation**; **Hæmo-cyanin**, -**erythrin**, -**globin**; **Lipo chrome**; **Melanin**; **Phycochrome**; **Turacin**; **Xanthochroism**; **Zoo-melanin**, -**erythrin**, -**xanthin**.

**Pileorhiza**. Root-cap. **Pileus**. Cap of sporophore; "umbrella" of mushroom or jelly-fish. **Pilidium**. Helmet-shaped, free-swimming, ciliated larva of cert. worms.

**Piliferous**, **Pilose**. Bearing hair.

**Piltown man**. Early pleistocene man somewhat intermediate between the earlier pliocene **pithecanthropus** and the later pleistocene **cromagnon man**. **Eoanthropus**. Geologically contemporaneous with **Peking man**.

**Pinacocyte.** Flattened cell in sponges.

**Pineal body.** A glandular and eye-like structure in brain, the tip of upgrowth from roof of thalamencephalon.

In iguana, lizards, sphenodon, and embryos of many other vertebrates its eye-structure is marked. Originally it appears to have been a pair of eyes which later fused into one median upward-looking eye. It is now an endocrine gland secreting a substance which influences growth of tissues, especially those of the sex-glands. The pineal eye is not represented in mammals and birds. Parietal body. Epiphysis. Epithalamus. Conarium. See Corpus luteum.

**Pinna.** "Shell" of ear; feather; wing; div. of pinnate leaf. **Pinnate.** Having leaflets of compound leaf on each side of a common leaf-stalk. **Pinnipedia.** S.O. of *Carnivora*, Seals, etc. **Pinnule.** Secondary leaflet of bipinnate leaf. Side branch at end of stem of crinoid. Tentacle.

**Pint.** (Br.) Half quart; 20 fluid ozs.; 0.125 gallon; 0.56825 litre; 568.25 c.c.

**Pipette.** Small glass tube for measuring liquids.

**Pisces.** Fish (*q.v.*).

**Piscicolous.** Dwelling (parasitically) inside fishes.

**Pistil.** F. sex organ; *stigma*, *style*, and *ovary*. Fused carpels. Syncarpous gynoecium. **Pistillidium.** F. sexual organ of bryo-, pterido-phytes, and gymnosperms. Archegonium. **Pistillody.** Conversion of floral parts into carpels.

**Pitch.** (1) Coal-tar by-product consisting of hydrocarbons. (2) Distance, measured parallel to axis, of any point on thread of a screw from a corresponding point on ad-

jacent thread. (3) A quality of sound depending on no. of aerial waves striking ear per sec.; the larger the no., the higher the pitch. *Ex.* pure pitch = 261.000; tempered pitch = 258.652. *Cf.* Intensity.

**Pith.** Medulla. Central region of dicotyledonous stem. Centre of ring of vascular bundles.

**Pithecanthropus.** Java ape-man. An extinct, late tertiary (early pleistocene or ? late pliocene) primate intermediate in characters between existing man and existing anthropoids.

It was somewhat between miocene dryopithecus and early pleistocene piltdown man. The cranium was about half that of modern man, having a capacity of 900 to 950 c.c. or about 400 c.c. greater than that of any living ape.

**Pituitary body.** Hypophysis. Infundibulum. An endocrine gland at base of brain.

In origin a three-chambered sac (as in young shark) beneath fore-brain and communicating with mouth. Its secretion influences growth of face and limbs, and disease of the gland leads to obesity, gigantism, and acromegaly. The hormone of anterior lobe stimulates milk-production, oestrus, normal ovulation, growth of adrenal cortex, skeleton, thyroid, and sex glands. The hormone of posterior lobe raises blood-pressure, slows pulse, contracts smooth muscles of intestines, uterus, and arteries, stimulates melanophores, and increases sugar-content in body-fluids. The gland is, in part, the eq. of the subneural gland of tunicates, and, in part, of the primitive vert. mouth which preceded the present one. The anterior lobe arises as a diverticulum of the primitive mouth, while the posterior arises as a downgrowth of floor of diencephalon.

**Pituitrin.** Hormone of pituitary body. **Infundibulin.** Hypophysin.

**Placenta.** (1) Vascular organ composed of interlocking fetal and maternal tissues in uterus of mammals (excepting monotremes and most marsupials) by means of which nutritive and respiratory solutions pass, by osmosis and without blood admixture, from mother to child, and waste products from child to mother. After-birth. (2) Parenchymatous cushion in ferns and allies to which stalk of sorus is attached. (3) Stalk connecting ascidian embryo to parent. (4) Part of carpel or floral axis on which the ovules grow. Secundine. **Placentalia.** *Sub.-cl.* of mammals, pregnant f. of which have a placenta. All mammals except monotremes and most marsupials. **Placoid.** Scaly.

**Plagiotropism.** Tendency of roots and branches to orientate themselves obliquely to the vertical axis.

**Planarians.** Ciliated flat worms. Turbellarians.

**Planck's constant.** Factor of proportionality by which frequency of an electronic oscillator must be multiplied in order to express a *quantum in ergs*. It is the circumference of smallest orbit in which an electron is moving in a hydrogen atom multiplied by the vel. and mass of the electron. The symbol is  $h$ , and  $h = 6.624 \pm 0.008 \times 10^{-27}$  (erg.-secs.).

**Plane of ecliptic.** Plane in which earth's orbit lies, and which passes through ecliptic (*q.v.*). **Planet.** One of nine bodies revolving in same direction around sun.

If  $d$  = distance from sun, and  $r$ , radius of planet, in miles, and  $m$ , be the mass in tons, then : *sun*,  $d = 0$ ;

$m = 195 \times 10^{33}$ ;  $r = 431,086$ . (1) *Mercury*,  $d = 35.3 \times 10^4$ ;  $m = 2.88 \times 10^{22}$ ;  $r = 1,550$ . (2) *Venus*,  $d = 67.2 \times 10^4$ ;  $m = 40.2 \times 10^{22}$ ;  $r = 3,844$ . (3) *Earth*,  $d = 92.9 \times 10^4$ ;  $m = 60 \times 10^{22}$ ;  $r = 3,950$ . (4) *Mars*,  $d = 141.4 \times 10^4$ ;  $m = 6.42 \times 10^{22}$ ;  $r = 2,098$ . (5) *Jupiter*,  $d = 483.2 \times 10^4$ ;  $m = 19,062 \times 10^{22}$ ;  $r = 43,263$ . (6) *Saturn*,  $d = 886 \times 10^4$ ;  $m = 5,688 \times 10^{22}$ ;  $r = 35,681$ . (7) *Uranus*,  $d = 1,782 \times 10^4$ ;  $m = 876 \times 10^{22}$ ;  $r = 15,810$ . (8) *Neptune*,  $d = 2,789 \times 10^4$ ;  $m = 1,020 \times 10^{22}$ ;  $r = 15,500$ . (9) *Pluto*,  $d = 3,712 \times 10^4$ ;  $m = 60 \times 10^{22}$ ;  $r = 3,950$ .

**Plankton.** Pelagic fauna and flora. An. and pl. population in surface zone (depth of light penetration) of seas and lakes, micro.-p.; macro.-p. *Phytoplankton* (e.g., diatoms) plus *zooplankton* (e.g., copepods). *Cf.* Nekton.

**Planoblast.** Free-swimming medusa. **Planocyte.** Phagocyte. **Planogamete.** Ciliated gamete, protoplast, or micro-zoospore. **Planont.** Amœbula.

**Plant.** An organism that uses inorganic solutions as food, takes its carbon from carbon dioxide in air and water and its nitrogen from nitrates and other simple N compounds.

The majority of pl. possess *chlorophyll* by means of which, with the aid of sunlight,  $\text{CO}_2$  is reduced, the O liberated, and the C is conjoined with  $\text{H}_2\text{O}$  and built up into starches, sugars, etc. Compared with the an. a pl. expends little energy in motion, is more anabolic, exhibits less div. of labour, and contains cellulose. *Cf.* Animal.

**Plantar.** *Per.* sole of foot. **Plantigrade.** Walking on the sole. *Ex. man*; bear.

**Planula.** Free-swimming, asexual, ciliated larva of cœlenterates. *Cf.* Sterrula.

**Plasm.** -a. Protoplasm. Also liquid part of blood.

**Plasmocyte.** Leucocyte.

**Plasmodiocarp.** Plasmodium

(*q.v.*) occasionally formed by free cells of echinoderms. **Plasmodium**. Multinucleate mass of protoplasm formed by union [*plastogamy* (*q.v.*)] of many amoeboid cells of *mycetozoa* (myxomycetes, *q.v.*; myxamoebæ), a union in which cell-bodies, but not their nuclei, fuse. *Syn.* syncytium. **Cenocyte**. Plasmodiocarp. *See* Plasmotomy. **Plasmodomous**. Able to construct protoplasm from inorganic materials. *Ex. pl.* *Cf.* Plasmophagous. **Plasmogamy**. *Plastogamy*. **Plasmogeny**. Origin of protoplasm from inorganic substances. *See* Cytogenesis. **Plasmogony**. Second phase in abiogenesis. *See* Autogony. **Plasmolysis**. Loss of water by pl. protoplasm with consequent cell-wall shrinkage. **Plasmophagous**. Living on protoplasm. *Cf.* Plasmodomous. **Plasmosome**. True nucleus. Nucleolus. *Linoplast*. *Cf.* Karyosome. **Plasmosphere**. **Perisphere**. **Plasmotomy**. Cleavage of plasmodium into two multinucleate parts. **Plasome**. Biophor. **Plasson**. Formative material in protoplasm. Gametoblast. Gametid. **Plastic**. Mean state between solid and liquid. Doughy. Continuous change of shape without disruption. Modifiable. Adaptable. Readily responding to environmental action. Formative. Metabolic. **Plastid**. Unnucleated cell. Chloroplast. Cytode. Pyrenoid. Protoplast. Chromatophore. Trophoplast. Primitive living element. Proteid-body in cytoplasm. Chlorophyll-containing body. Cell unit. Tonoplast. Biophor.

Amylo-, Chloro-, Chromo-. Leuco-plast. **Plastochondria**. Mitochondria. **Plastogamy**. Plasmogamy. Fusion of *cytoplasm* (not nucleoplasm) of two or more cells to form plasmodium. **Plastomere**. Chondriomere, -some. **Plastron**. Sternum. Under side of cephalothorax. Ventral shield of tortoise. *Cf.* Carapace.

**Platinum**, *ch. el.* Pt. Metal. *At. no.* 78; *at. wt.* 195.230.

**Platycephaly**. *See* Acrocephaly.

**Platyhelminths**. Flattish worms; turbellarians, flukes, tape-worms, etc. **Platypus**. Ornithorhynchus. **Platyrhines**. New World monkeys, usually tailed, with forward and outwardly directed nostrils. *Cf.* Catarrhines.

**Pleiopod**. Pleopod. Crustacean abdominal limb. *Cf.* Pereiopod.

**Pleiotaxy**. Having many whorls as in double flowers.

**Pleistocene**. Last epoch of cenozoic. Glacial periods between pliocene below and holocene above.

**Plenum**. *Fully* occupied space. *Opp.* vacuum.

**Pleomorphism**. Having two or more forms. Polymorphism. **Pleopod**. Pleiopod (*q.v.*).

**Plerergate**. Worker ant with stomach enormously distended with food. **Plerome**. Central, undifferentiated, cell zone in a growing point.

**Plesiosaurians**. Long-necked, marine, mesozoic, reptiles with four pentadactyl paddles.

**Pleura**. Membrane lining thorax and investing lungs. **Pleurococcus**. Unicellular green alga (*chlorophyceæ*) com-



mon on tree-trunks. Proto-, Chloro-coccus. **Pleurotribe.**

**App.** heterogamous flowers with anthers and stigma so placed as to rub against entering insects, thus ensuring cross-pollination.

**Plexus mirabile.** Network of nerves and vessels in limbs of human embryo to about 7th week; permanent in cert. lemurs. **P., solar.** Collection of nerve-ganglia supplying abdominal viscera.

**Plica semilunaris.** Vestigial fold of conjunctiva in inner corner of eye of man, representing remains of third eyelid or nictitating membrane (*q.v.*) of birds and reptiles.

**Pliocene.** Sub-div. of cenozoic, below pleistocene, above miocene.

**Plumule.** Bud between seed-leaves. Growing point of embryo-stem. **Geoblast** (*q.v.*). Down-feather. **Androconium.**

**Pluteus.** Free-swimming echinoderm larva.

**Plutonic.** *Per.* holocrystalline, igneous rocks. *Et.* granite.

**Pneumatophore.** Air-sac. Air-bladder. **Pneumotaxis.** Response to stimulus of gases, air, CO<sub>2</sub>, O, etc. **Aerotaxis.**

**Pod.** Dry, dehiscent seed-receptacle. A carpel-composed fruit. *See* Silique; Legume.

**Pod-eon, -eum.** Stalk connecting thorax (*propodeon*) and abdomen (*metapodeon*) of hymenoptera. **Podetium.**

Stalk-like structure—*e.g.*, that of ascocarp.

**Podex.** Pygidium. Anus.

**Podite.** Limb segment.

**Podium.** Support. Tube-foot.

**Podogynium.** Stipe of gynæcium. **Gynophore.** **Podophthalmic.** Stalk-eyed.

**Poikilocyte.** Misshapen, diseased, red blood-cell. **Poikilotherm-al, -ic.** Having body temp. equal to that of environment. "Cold-blooded." *Cf.* Homoiothermic.

**Polar bodies.** Two minute cells thrown out of ovum prior to fusion of m. and f. pronucleus. Aborted daughter-cells of ovum.

They are possibly extrusions of m. substance already in ovum to prevent parthenogenesis. One may regard "expulsion" of p.b. as a div. of original ovum into four cells, three of which abort and one is fertilized. Three-fourths of chromatin in *original* nucleus are said to lie in the p.b. *Syn.* polocytes.

**Polarization.** (1) Deposit on electrodes of gases—especially H—during passage of electric current which set up an opposing E.M.F. (2) Action on a radiation—*e.g.*, light—so that its vibrations, instead of being in all directions, take up a definite conformation. (3) Definite orientation of paramagnetic mols. in a magnetic field. **Poles.** Battery terminals. Anode and cathode. Points near ends of bar-magnet.

**Polioplasm.** Spongioplasm.

**Pollen.** Microspores (unripe p.) and m. gametophytes (ripe p.) of pl. m. gametes or fertilizing cells borne on anthers of flowers.

An early p.-grain is a single cell which divides into three cells—(1) vegetative cell which forms the *p.-tube* (*q.v.*); (2) m. gamete which passes down pollen-tube and fertilizes ovum; (3) cell which unites with secondary nucleus to form fusion-nucleus.

**P.-basket.** P.-receptacle on hind-leg of bee. **Corbicula.**

**P. brush.** Brush-like p.-collecting organ. **Scopa.** Sero-

thrum. **P. sac.** Sac containing **p. Microsporangium.** **P. tube.** Tube made by **p. vegetative-cell** (*q.v.*) which has fallen on a stigma.

The tube is formed by *intine* forcing itself through *ectine*; it passes down style and enters first the ovary, then an ovule, and finally the oosphere or egg-cell. The **m.** fertilizing cell then passes down the tube and reaches the egg-cell; it may then pass through a *micropyle*, an aperture in end of egg-membrane or through the ovule-stalk at end *opp. micropyle*, or it may enter ovum at some midpoint. These three types of fertilization are known respectively as *porogamy*, *chalazogamy*, and *mesogamy*.

**Pollination.** Transfer of pollen from androecium (stamens) to gynoecium (stigma). Agents: anemophily, wind; entomophily, insects; hydrophily, water; malacophily, snails; ornithophily, birds; pterophily, bats. **Pollinoid.** (1) Resembling pollen. (2) Pl. **m. gamete** (*q.v.*).

**Polocyte.** Polar body.

**Polonium, ch. el.** Po. Radioactive element. *At. no.* 84; *at. wt.* 210.0. *Sym.* radium F.

**Polyandry.** Having many (20 or more) stamens. Having more than one **m. mate.** *Cf.* Mono-, Poly-gamy. **Poly-chæts.** O. of marine worms. **Polyembryony.** Production through polyspermy of two to several hundred embryos from a single ovum. It is probably the cause of "monsters," and of "identical twins" (*q.v.*). **Polygamy.** Having more than one mate of *opp. sex* at same time. Having staminate, pistillate, and hermaphrodite flowers on one pl. **Triceious pl.** *Cf.* Polygyny. **Polyandry;** **Monogamy.** **Polygon.** A many- (usually more than four) angled,

many-sided figure. **Polygoneutic.** Having many broods in a season. **Polygyny.** Having many styles. Consorting with many **f. mates** at same time. **Polyhedron.** Solid of many plane faces. **Polymastigote.** Having many flagella in a bunch. **Polymastism.** **Polythely.** **Polymerization.** Formation of groups of mols. which move about in a solution in a like manner to single mols. *Ex. colloid.* Formation of micellæ. Union of two or more similar mols. to form a compound with higher mol. wt. and different physical properties, but possessing same els. in same proportions. **Poly-morphism.** Power of assuming different forms, appearances, and structures. Having different types of organs as in "nutritive," "reproductive," "sensitive," or "protective" "persons" of coelenterates, or as in the winged, wingless, sexual, and asexual worker, and soldier-ants. **Pleomorphism.** **Polyp.** Separate zooid of a colony. Simple actinozoon. **Hydra.** **Sea-anemone.** A typical **p.** has a hollow cylindrical body with walls of ecto-, and endo-derm. **Polyparium.** Common base and investment of polyp colony. **Zoarium.** **Polypetalous.** Having many free petals. *See* Flower. **Polyphyletic.** Having descent along more than one line of origin and combining more than one ancestral characteristic. **Polyphyodont.** Having many successive sets of teeth. *Ex. shark.* **Polypide.** Individual zooid. **Polyploid.** Individual with reduplication of chromosome no.—i.e., pos-

sessing a chromosome no. which is a multiple of basic haploid no. An organism with more than two complete sets of homologous chromosomes. **Polypterus**. An air- and water-breathing fish of Nile that illustrates transition stage from fish to amphibian; its swim-bladder is both hydrostatic and respiratory in function. **Polyspermy**. Fertilization of ovum by more than one m. gamete. Having many seeds. See **Polyembryony**. **Polythely**. Having supernumerary nipples on supernumerary mammae. **Polymastism**. **Polytocous**. Producing many at a birth. **Polytrophic**. Deriving food from more than one type of organic substance. Nourished by different kinds of hosts. Having a nutritive cell attached to ovum. **Polyzoa**. **Zoophytes**. **Bryozoa**. **Polyzoarium**. Protective and supporting skeleton of polyzoan colony. **Polyzoon**. Colony of zooids. A unity of polypides. A spore containing sporozoites. **Porifera**. Sponges, etc. **Porogamy, bot.** Fertilization of ovule through a *micropyle*. *Syn. aerogamy. Cf. Chalazogamy. See Pollen.*

**Positron**. The *positive electron*.  $+^0p$ .

The *p.* is a constituent in cert. circumstances of nucleus of atoms; thought by some to be a disintegration product of the nucleus of atom (*q.v.*) when a cosmic-ray photon collides with it. Light elements—*e.g.*, boron—emit a stream of positrons when bombarded by alpha particles or by neutrons (*q.v.*). Positrons are also emitted by elements (*e.g.*, Al, Pb, U, etc.) under action of gamma waves. The *p.* has a + charge and a mass of the order of that of a negative electron (*q.v.*). The *p.* demands an enormous expenditure of energy for

its production and, as might be expected, possesses immense penetrating power. To produce an electron requires some 509,000 electron-volts, but the production of a positron requires an expenditure of about a million electron-volts. In passing through  $\frac{1}{2}$  inch of lead at 63 electron-volts it emerges still possessing 23 electron-volts.

**Potash**. Carbonate of potassium. Pearl ash. Also *app.* oxides of potassium. **Potassium, ch. el. K. Metal. At. no. 19; at. wt. 39.096.**

**Potential, elec.** Deg. of electrification—*e.g.*, a neutral atom has higher *p.* than an at. with a deficit of neg. electrons (+ charged at.), and an at. with a surplus of neg. electrons (— charged at.) has higher *p.* than either a neut. at. or an at. deficient in neg. electrons. The greater the excess of neg. electrons the higher the *p.* **P. difference, elec.** A measure of *p.* energy available between two points and represented by one unit of work per sec. while maintaining unit current. The difference in the no. of neg. electrons—surplus or deficit—in two bodies of same material. The amount of work required to bring unit charge from one point to another. **Tension. P. energy.** Energy not being used. Power of doing work which a body possesses in virtue of its *position*. Energy associated with configuration of electrical systems. Static energy. *Cf. Kinetic energy.*

**Pound. (Av.)** 7000 grains. 1/2240 Br. long ton. Mass of 27.692 cub. in. pure water weighed in air at 4° C. 760 mm. p. 453.59243 gramme. (*Tr.*) 5760 grains. 3.6735 × 10<sup>-4</sup> Br. long ton. 373.2418 gramme. **Poundal. Force**

which imparts to a 1 lb. mass an acceleration of 1 ft. per sec. per sec.

**Power.** Rate of doing work. Unit is a rate of 1 erg per sec. Practical unit is the *watt* or  $10^7$  ergs per sec., or 1 volt-amp, or 1 joule per sec. One *horse-power* = 746 watts or 33,000 ft.-lbs. per min. *Math.* Product arising from continued multiplication of a no. by itself—e.g., the square is the second, the cube the third, power of a no. *Optics.* Degree to which a lens magnifies.

**Præcoces.** Birds able to look after themselves when hatched. *Nidifugæ.* *Cf.* Altrices.

**Praseodymium, ch. el.** Pr. Metal. *At. no.* 59; *at. wt.* 140.92.

**Precession of equinoxes.** A backward (westward) movement of equinoctial points in ecliptic (in consequence of major pull of moon and sun on equatorial bulge of earth) so that: (1) each year sun crosses equator earlier than year before; (2) each day the equinox comes to meridian sooner than it would have done if there were no precession movement—i.e., no conical rotation of earth's axis around pole of ecliptic. **Premolars.** Two teeth (8 in all) between canine and molars. *Bicuspid.*

**Preoperculum.** The fore-dermal bone of a gill-cover. *See* Operculum. **Prepuce.** Integument covering glans penis. *Foreskin.*

**Pressure.** Force against opposing force. Force per unit area. *Elec.* tension; voltage; potential. E.M.F. unit of p. is 1 dyne per sq. cm. *Meteoro-*

logical unit is the *bar.* =  $10^8$  dynes per sq. cm. One normal *atmosphere* at 0° C. and 760 mm. (g. = 980.665) = 1.01325 *bar.* or 14.6974 lbs. per sq. in. or 1.03326 kgs. per sq. cm. *See* Critical; Stress.

**Primates.** Highest O. of mammals, including tarsius, lemur, monkey, ape, man. *See* Classification; Hominidæ.

**Primine.** External integument of ovule, though often *app.* internal because it is formed first. **Primitive groove.** Furrow in epiblast of primitive streak marking primitive gut. **Primitive streak.** Opaque streak in vert. blastoderm on hinder part of embryo; the neurenteric canal leads from fore-end to yolk-sac or archenteric vesicle. The primitive streak and groove represent an ancient mouth or blastopore. **Primordial ova.** Large cells in germinal epithelium of embryo; the fore-runners of true egg-cells. *See* Ovum. **Primordial utricle.** Protoplasmic lining of pl. cell next cell-wall.

**Prism.** Transparent structure with two plane faces meeting at an edge.

**Proboscidea.** Elephants.

**Procelous.** *App.* cup-and-balled vertebra—i.e., each vertebra is cupped anteriorly, rounded posteriorly. *Ex.* most reptiles. *Cf.* Amphicelous; Opisthocelous.

**Procryptic.** Having protective mimicry effecting concealment.

**Proctal.** *Per. anus.* **Proctodæum.** Terminal part of alimentary canal or outermost part of cloaca. That part of hind-gut which arises from epi-

blast—*i.e.*, not from hypoblast.  
*Opp.* stomodæum.

**Progeotropism**, -y. Pos. geotropism (*q.v.*). **Prognathous**. Having projecting jaws —*i.e.*, facial angle (*q.v.*) below 80°. **Prohydrotropism**. Pos. hydrotropism.

**Prominences, solar**. Gaseous projections from sun's chromosphere extending upwards 50,000 to 350,000 miles.

**Pronation**. Rotation of forearm turning palm downwards. *Opp.* supination. **Pronephros**. First of three stages in kidney ev. It resembles that of lower fishes and reaches highest development in human embryo about fourth week. **Pronograde**. Locomotion "on all fours" with trunk horizontal. *Cf.* Orthograde. **Pronucleus**. The chromosome-reduced nucleus of ovum or spermatozoon after expulsion of two polar bodies (*q.v.*), but before the two nuclei have fused in the fertilization act. *See* Germinal vesicle. **Pronymph**. A pupal stage in diptera during which new organs are formed after histolysis of old ones.

**Proof spirit**. (*Br.*) Alcohol which, at 51° F., weighs 12/13 of an = measure of pure water, and which contains 49.28 p.c. by wt., or 57.10 p.c. by vol., of alcohol.

**Prophase**. Stage in mitosis when *spireme* is formed. *See* Meiosis.

**Prophototropism**. Pos. phototropism. **Prophylaxis**. Prevention of disease. **Prophyllum**. Bracteole. **Pro-pode-on**, -um. Abdominal region in front of po-deon (*q.v.*). **Epinotum**. **Propodite**. Foot-segment, sixth from body, in

malacostraca. **Propodium**. Front of molluscan foot. **Propolis**. Resinous, waxy material of opening buds used by bees as wax.

**Proprioceptor**. Receptor that supplies information concerning condition of organs or parts within the organism itself—*e.g.*, muscle-sense. *See* Kinæsthesia. *Cf.* Extero-, Intero-ceptor. **Proptosis**. Protrusion of eyeball. **Proscölex**. Bladder-worm (larval) stage of tape-worms. **Redia** of trematodes. **Onchosphere**. **Prosencephalon**. Fore-brain. **Telencephalon**. **Prosenchyma**. Groups of elongated cells with little protoplasm in pl. *Cf.* Parenchyma.

**Prostate gland**. Musculo-cutaneous sex-gland secreting a viscid lubricant. It surrounds commencement of urethra in m.; in f. it is arrested soon after appearance of ovaries.

**Prostemmatic**. *Per.* eyes of cert. insects that have a small sense-organ in front of them.

**Prostomium**. In molluscs and worms that part of head anterior to mouth. **Protagonist**. Agonist (*q.v.*). **Protandrous hermaphrodite**. Hermaphrodite which produces spermatozoa first and ova later. *Ex.* myxine. **Protandrous**, -y. Pollen dissemination by stamens before stigma of same pl. is sticky and ready for pollen capture. *Cf.* Protogyny. Development of m. organs and ripening of spermatozoa in hermaphrodite organism prior to development of f. organs and ripening of ova. All such devices prevent self-fertilization. Appearance

of m. earlier in season than f.  
*See* Dichogamy.

**Protease.** Protein-splitting enzyme. **Protei-d, -n.** Albuminoid. One of many complex nitrogenous compounds forming chief constituent of protoplasm.

A p. is a complex combination of amino-acids and is synthesizable from inorganic materials by pl. This nitrogenous carbon compound has a relatively gigantic mol. containing smaller mols. of amino-acids which together contain hundreds, sometimes thousands, of atoms. Mol. wt. of albumin is 42,000, of *protease* (the first cleavage product of the protein mol.) 2,900, and of *peptone*, 325. Mean formula of a p. mol. is  $(C_{14}H_{21}N_5SO_4)_n$  and as mol. wt. probably exceed 15,000 n. is not less than 3. Proteins include albumins, globulins, histones, peptones, peptides, etc. Proportion of proteins in foodstuffs: cheese, 25.7 p.c.; lean meat, 20.7; fish, 19.7; peas, beans, 18.1; egg, 12.3; white bread, 7.1; milk, 3.3; potato, 1.9; butter, 0.2 p.c.

**Proteles.** Aard-wolf. **Protentomon.** The common, ideal, insect type. *See* Archetype. **Proteoclastic.** *App.* enzymes which break up proteins into amino-acids. **Proteolytic.** *App.* ferments which convert proteins to proteoses, peptones, etc. *Ex.* pepsin. **Protease.** *See* Protein. **Proterozoic.** Era preceding palaeozoic. Beginning of huronian to end of keweewan. **Prothallium, -us.** Sexual gametophyte (*q.v.*) phase of pteridophytes bearing antheridia and archegonia.

The f. p. of pteridophytes is homologous with endosperm of *pinus*, while the m. p. is homologous with the prothallial cell which arises from the pollen grain and produces the antheridial cell. In ligulate, a microspore produces the antheridium or m. p. and a megaspore produces the archegonium or f. p. *See* Alternation of generations.

**Protist.** Lowest known visible living unit; neither an. nor pl., but more primitive than either. Protobiont. Non-nucleated cell. Akaryote. **Protistology.** *See* Cytology.

**Protoactinium, ch. el.** Pa. Radioactive el. *At. no.* 91; *at. wt.*  $230 \pm 0.5$ . **Protobiont.** Protist (*q.v.*). **Protoblast.** (1) Naked, wall-less cell. *Cf.* Deutoblast. (2) Blastomere. (3) First embryonic layer. (4) Fertilized ovum. **Protocercal.** Most primitive type of fish-tail with long axis of body dividing the fin into two equal parts, a dorsal and ventral lobe. Present in primitive fishes and in embryonic and larval higher fishes. *Cf.* Di-phyercal.

**Protococcus.** **Protophyte.** A pl. that derives all its nourishment from another pl. and the air. **Protogynous, -y.** Condition of hermaphrodites in which f. sex-organs develop and function before the m. ones. *Ex.* dichogamous flowers in which stigma and pistil ripen before stamens of same pl. so that stigma is available for reception of pollen only from another pl. *Ex.* apple. *See* Dichogamy; Protandry. **Prothippus.** Pliocene horse. **Protomyxa.** Myxomycetes.

**Proton.** *Sym.*  ${}^1\text{H}^+$ . Constituent of nucleus of all atoms. Unit of pos. elec. The pos. charge of the fundamental unit of elec. The nucleus of the light isotope of hydrogen.

The main mass of an atom (*q.v.*) lies in its p. or protons. The relative mass of a p. where  $0^{16} = 16$ , is approximately 1.0081, while the actual mass is  $1.67248 \times 10^{-24}$  gramme. The charge on the p. is  $1.591 \times 10^{-19}$  coulomb or  $+4.774 \times 10^{-10}$  E.S.U.,

while that on the neg. electron is  $-4.774 \times 10^{-10}$  E.S.U. The diameter of a p. is much less than that of an electron, the former being probably  $10^{-16}$  cm., while the latter is  $10^{-13}$  cm. Protons repel one another and also repel positrons or pos. electrons; they attract neg. electrons. When united with a neg. electron, the pair form a *neutron*, or the p. may be regarded as a neutron + positron. The no. of protons in an atom represent its *atomic weight* (*a.w.*). Light travels through space as *waves*, protons as *particles*, but when protons collide with "matter" they then behave as waves. *Freq.* of p. is much greater than that of electron, being of an order of  $229 \times 10^{21}$  oscillations per sec. An el. of *at. wt.* W and *at. no.* N always has a *nucleus* = W protons plus W-N electrons, surrounded by N orbital electrons.

**Protonema.** Filament of germinating asexual spore in bryophytes and from which the (moss) pl. develops. It is the "thalloid" stage of moss (and some liverworts) gametophyte. See Alternation of generations. **Protonephros.** Pro-, meso-, and metanephros. **Protopathic.** *Per.* primitive, unspecialized, sensory discrimination—pain, heat, contact, etc. *Opp.* epicritic. **Protophyte.** Any unicellular pl. *Cf.* Protozoon. **Protoplasm.** Living matter. Physical basis of life. **Cytoplasm.** **Karyoplasm.**

In a *cell*, p. consists of clear ground-substance or *hyaloplasm* and a granular, thread-like reticulum, the *spongio-plasm*, the living substance wherein chromatin granules and filaments lie. p. is a complex physicochemical aggregation in which albumens, fats, carbohydrates, proteins, water, dissolved gases, and ions of salts form a united system. The mol. of p. approximates  $C_{450}H_{720}O_{140}S_2N_{116}$ . P. —i.e., spongioplasm—acts on other substances—e.g., hyaloplasm—like a ferment, producing great changes in what it acts on with a min. of change in itself. While spongioplasm is *alive*, hyaloplasm is not strictly alive, but is very plastic and labile. P. is

constantly being unmade and remade —i.e., is in perpetual change. Our surest knowledge of it is that in our own brains its activity is expressed as thought. "While the transfer of energy into an inanimate material system is attended by effects retardative of the transfer and conducive to dissipation, the transfer of energy into any animate material system is attended by effects conducive to the transfer and retardative of dissipation" (J. Joly). Three-fourths, by wt., of protoplasm is water. *Syn.* bio-, eo-, nucleo-, cyto-, kino-, archo-, morpho-, gono-plasm; sarcode, etc.

**Protoplast.** All protoplasm of a cell regarded as a unit. **Protest.** **Plastid.** See Z.-spore. **Protopodite.** Basal segment of arthropod limb. **Protopterus.** African dipneust fish. **Prototheria.** Primitive, non-placental, egg-laying mammals. **Prototrophic.** Capable of feeding on inorganic substances and uncombined els. **Protozoa.** One of two great divs., the other being the *metazoa*, that make up the an. kingdom. Unicellular, solitary, or colonial an. that multiply by fission. There are 10,000 species (*q.v.*) of protozoa and these include: sarcodina, mastigophora, infusoria, sporozoa. **Protozocea.** Crustacean larva succeeding nauplius. **Proventriculus.** Gizzard (*q.v.*)

**Proviron.** Testicular hormone ( $C_{16}H_{26}O_2$ ) promoting sexual desire.

**Proximal.** End of limb nearer body-axis. *Opp.* distal.

**Psalterium.** Third chamber of ruminant stomach. Manyplies. Omasium.

**Psammophilous.** Living in sandy places.

**Pseudoposematic.** Imitating the protective warning coloration, etc., of noxious animals. **Pseudimago.** Intermediate

stage in cert. insects between pupa and imago (*q.v.*). **Pseudo-mitotic**. Diaschistic (*q.v.*). **Pseudopodium**. Improvised limb consisting of a temporary protrusion of protoplasm from a cell. **Myxopodium**. Support of a moss sporogonium. **Pseudova**. Parthenogenetic ova that develop without m. fertilization.

**Psychiatry**. Treatment of mental disease. **Psycho-analysis**. Interpretation of the content and mechanism of the mental state. **Psychopathy**. Mental disorder. **Psychozoic, geo.** Age of man.

**Psychrophilic**. Thriving in cold environment. **Psychrophobic**. Avoiding cold.

**Pterergate**. Worker or soldier ant with vestigial wings. **Pteridophytes**. Flowerless pl. Vascular cryptogams. Ferns, horsetails, lycopodiums, etc.

**Pterocarpous**. Having winged seeds. **Pterospermous**. **Pterodactyl**. Mesozoic flying reptile. **Pterosaurs**. **Pteropædes**. Birds able to fly soon after hatching.

*Ex.* mound-birds. **Pterophilous**. *App.* pl. pollinated by bats. *Ex.* freycinetta. **Pteropod**. Gastropod. **Pteropodium**. "Foot" of gastropod.

Wing-bearing feet of bat. **Pterosaurs**. O. of flying reptiles. *Ex.* pterodactyl. **Pterospermous**. **Pterocarpous**.

**Pterygium**. Generalized limb—arm, leg, fin, wing. **Pterygoid**. Wing-like. **Ptery-læ**. Tracts in bird's skin from which feathers grow. *Cf.* Apteria.

**Ptomaines**. Alkaloids—waste-products of bacteria.

**Ptcis**. Drooping, especially of upper eyelid.

**Ptyalin**. Digestive ferment

(amylase) of saliva; it turns starch to maltose.

**Pubescence**. Downy hairs. **Puccinia**. "Rust" fungi. Corn-mildew. *Uredinales*.

**Pudendum**. External f. genitalia.

**Pullulation**. Prolific reproduction. **Gemination**.

**Pulmonary**. *Per.* lungs.

**Pulmonates**. Molluscs that breathe by lung-sacs. *Ex.* snail.

**Pulsatile vacuole**. **Contractile vacuole**.

**Pulse**. Wave of high pressure starting from heart at its contraction and spreading throughout whole arterial system. Frequency varies from 80 in young, to 65 in old, people. **Pulseilum**. A posterior (pushing) flagellum. *Cf.* Tractellum.

**Pulvillus**. Pad. Cushion. **Onychium**. **Empodium**. Pad at base of petiole which enables leaf to re-orientate itself. *Syn.* pulvinus.

**Pupa**. Stage in insect development following larval and preceding imaginal. Late stage of dipterula. Sometimes surrounded by silk cocoon. *Instar*. **Chrysalis**. **Pro-nymph**. **P. coarctata**. When larval skin acts as a case. **Puparium**. **P. libera**. When limbs are free within case. **P. oblecta**. A p. in which the skin glues together all appendages. *Ex.* butterfly. **Puparium**. p. coarctata.

**Pus**. *See* Abscess.

**Pusule**. Contractile vacuole.

**Putamen**. Egg-shell membrane. **Endocarp**. "Stone" of fruit.

**Pycnidia**. Spore fructifications (spermogonia) bearing conidiophores. **Pycnidio-**



**phore.** Pycnidia bearing conidiophores.

**Pycnidiospore.** Spore of pycnidia. Pycnoconidium. Spermatium. Pycniospore. Pycniospore. Pycnidiospore. Pycnoconidium. Pycnidiospore. Pycnogonidium. Pycnogonidia. Spider-like marine arthropods. Podosomata. Pantopoda. Pycnogonidium. Pycnoconidium. Pycnosis. Cell-nucleus degeneration.

**Pygal.** *Per.* region of rump. **Pygidium.** Caudal region of invertebrates. Terminal tergite. **Pygostyle.** Fused coccygeal vertebrae which carry tail-feathers in birds.

**Pylorus.** Distal orifice or region of stomach.

**Pyorrhoea.** Discharge of pus from tooth-sockets.

**Pyrene.** Stony endocarp of fruit. **Drupe stone.** **Pyrenin.** Substance of nucleus or nucleolus. Perithecium. **Drupe.** **Paranuclein.** *Syn.* **Pyrenocarp.** **Pyrenin.** **Pyrenoid.** Colourless mass of protein material, being the reserve food-stuffs and starch-forming bodies in chloroplasts. *Syn.* leucoplastid. Resembling a pyrene.

**Pyrexia.** Fever with raised temp. **Pyrites.** Metallic sulphide ores. **Pyrometer.** Instrument for measuring high temperatures.

**Pyroxylin.** Hexanitrate of cellulose. **Guncotton.**  $C_{12}H_{14}O_{22}N_6$ .

## Q

**Quadrant.** Quarter of a circle. Arc subtending  $90^\circ$ , radii perpendicular.

**Quadrangle.** Square. *Zoo.* (1) Bone of great evolutionary significance in skull of fish, amphibian, reptile, and bird; on it hinges the lower jaw. Probably represented in higher vertebrates (man) by the *incus* in ear. *Syn.* *hypotympanic*. (2) Lobe of brain. *Syn.* *precuneus*. (3) Lobe of liver. (4) Muscle of upper lip or of buttock.

**Quadri-ceps.** Thigh muscle with four "heads." **Q.-farious.** (1) In four rows. (2) Proceeding from four sides of a branch. **Q.-fid.** *bot.* Deeply cleft into four parts. **Q.-foliate.** *App.* compound palmate leaf with four leaflets arising at a common point. *Syn.* *q.-nate*. **Q.-geminal bodies.** *Corpora quadrigemina* of brain. **Q.-jugate.** *App.* pinnate leaf

with four paired leaflets. **Q.-locular.** *bot.* *App.* ovaries, etc., possessing four chambers. **Q.-maculate.** *bot.* Having four spots. **Q.-nate.** *Syn.* *q.-foliate* (*q.v.*). **Q.-pennate.** *bio.* Four-winged. **Q.-tubercular.** *App.* teeth with four tubercles.

**Quadru-mana.** *An.* with handlike fore- and hind-feet. **Q.-manous.** 4-handed. **Q.-ped.** 4-footed *an.* *Syn.* *tetrapod*.

**Quantum.** The fundamental unit, or ultimate finite quantity, of radiation. *Syn.* (for light) photon.

Quanta differ in amount according to kind of radiation, for they are dependent on  $w.l. \times \text{freq.}$ —e.g., blue light has higher freq. than red, hence a blue light q. has more energy than a red light q. The longer the *w.l.* the smaller the q., and *vice versa*. When a planetary electron moves to from an outer an inner orbit, a q.

is radiated from the atom. When a  $q.$  enters an atom it forces an electron either to leave the atom or to move from an inner to an outer orbit. The  $q.$  of a radiation is  $h \times fr.$  where  $fr.$  is the frequency and  $h$  (Planck's constant) or energy  $\times$  time—i.e.,  $6.542 \pm 0.0083 \times 10^{-27}$  erg sec. See Light; Photon.

**Quartz.** Rock-crystal. Usually 6-sided prisms of silica, ending in 6-sided pyramids.

**Quaternary.** *App.* flowers with four parts in whorl. *Syn.* tetragonal. *Geo.* Later cenozoic period.

**Quaternate.** *App.* leaves that grow in fours from one point.

**Queen.** A functionally-fer- tile f. individual (with de- veloped ovaries) in bees, wasps, ants, and termites.

**Quill.** *Syn.* *calamus*; *oar- feather.* Tubular axis of

feather. Wing-quills are called *remiges*, tail-quills, *rectrices*.

**Quinary.** *App.* flowers with five parts in whorl. *Syn.* pentagonal.

**Quinate.** *App.* leaves that grow in fives from one point.

**Quin-cuncial.** *Per.* **Q.-cunx.** Arrangement of five petals or five leaves, two of which are exterior, two interior, and one partly exterior, partly interior.

**Quinque-costate, bot.** Hav- ing five-ribbed leaves. **Q.- cuspidate, zoo.** Having five cusps or tubercles on a tooth. *Syn.* **q.-tubercular.** **Q.-fari- ous, bio.** In five directions. In five parts. **Q.-fid, bio.** Divided into five parts. *Syn.* **q.-partite.** **Q.-foliate.** Having five leaves. **Q.-partite, q.- fid (q.v.).** **Q.-tubercular.** **Q.- cuspidate (q.v.).**

## R

**Race.** A relatively perma- nent collection of varieties of organisms with resemblances to one another which do not, however, mark them off enough from other forms to constitute a species. A div. of mankind possessing sufficient constant heritable traits to characterize it as a distinct and relatively permanent variety of the genus *homo*.

**Racemation.** A cluster.

**Raceme.** A centripetal in- florescence in which a primary axis bears lateral branches forming both pedicels and flowers in acropetal succession. *Ex.* hyacinth. **Racemic acid.** Dextro- plus lævo-tartaric acid. **Racemose.** Having clustered flowers, fruits, or leaves—i.e., an inflorescence

in which the main axis does not end in flowers, etc., but produces them in a regular lateral manner. An Indefinite Inflorescence. *Cf.* Cymose.

**Rach-ial, -idial, -iform.** *Per.* or shaped like a rachis. **Rachio- dont.** Having vertebræ modi- fied as teeth. *Ex.* egg-eating snakes. **Rachis.** Any axial structure such as the back- bone, or a stalk, shaft, quill, spike, etc. **Rachitomous.** Having vertebræ with jointed, unfused centra (extinct am- phibia and reptiles). *Syn.* temnospondylous. *Cf.* Stereo- spondylous.

**Radial velocity.** The vel. of a body in the direction of its radius-vector. The vel. of relative approach or recession of a heavenly body as deter-

mined by spectral line shift.  
**Radialia.** Fin-rays.

**Radian.** Angle subtended by arc of a circle = in length to a radius. It =  $57.2958^\circ$ .  
*See Velocity, Angular.*

**Radiance.** Radiation intensity. **Radiant.** Emitting r. energy. **R. energy.** The potential and kinetic e. associated with electromagnetic waves. **Radiata.** Group of invertebrates with radial symmetry. *Ex.* starfish; jellyfish. **Radiate.** Radially symmetrical. Having ray-florets.

**Radiation.** Heat, light, etc. Fluorescence. Energy, unassociated with matter, traversing space. An electromagnetic wave, or its process of emission from atoms. **R. pressure.** Light-pressure.

Pressure exerted on matter by radiant energy. In solar atmosphere it amounts to about 69 tons on a sq. mile of black surface; on our earth it is about 2.6 lbs. per sq. mile or 114,700 tons on hemisphere facing the sun. **R. resonance.** *See Fluorescence.* **R. unit.** A quantum.

**Radical.** *Syn.* radicle. Root. *Ch.* A basal atomic group which remains unchanged during ordinary reactions of the compound of which it is a part. *Ex.*  $\text{NH}_4$ , ammonium;  $\text{C}_2\text{H}_5$ , ethyl. **Radican.** Stem-rooting. *Ex.* ivy. **Radicle.** *Syn.* radical. A rootlet, especially of pl. embryo. *See Hypocotyl.* **Radicolous.** Living upon, among, or in tissues of, roots. **Radicose.** Large-rooted. **Radiculose.** Having many rootlets.

**Radio.** *Per.* radiation and electric phenomena of frequencies  $10^4$  to  $10^{11}$ . The

transmission and reception of electromagnetic waves.

**Radio-actinium, ch. el.** Rd-Ac. Isotope of thorium (*q.v.*). *At. no.* 90; *at. wt.* 227. It has an av. life of 28.1 days and emits  $\alpha$ - and  $\beta$ -particles.

**Radio-activity.** Conditions of substances the atomic nuclei of which are perceptibly disintegrating with emission of  $\alpha$ -particles, and/or  $\beta$ -particles, and/or  $\gamma$ -waves.

Probably all substances are radio-active in some degree, Ra, U, and Th in high degree. The  $\alpha$ -particles are He nuclei, the  $\beta$ -particles high-velocity electrons, and the  $\gamma$ -waves short electromagnetic waves.  $\delta$ -particles (low-vel. electrons) and recoil-atoms (the residue of atoms after expulsion of  $\alpha$ - and  $\beta$ -particles) are other products of radio-active disintegration. *See Uranium.*

**Radiolaria.** Marine unicellular organisms with perforated siliceous skeletons.

**Radiothorium, ch. el.** RaTh. Metal. Average life-period 2.9 years. *At. no.* 90; *at. wt.* 228.0. *See Thorium.*

**Radium, ch. el.** Ra. Radio-active metal. *At. no.* 88; *at. wt.* 226.05. Av. life-period 1,600–2,300 years. For genesis and disintegration products *see Uranium.*

**Radius.** Straight line from centre of circle to circumference. It = circumference  $\div 6.28318$ . Outer of two bones of fore-arm. A radial line or plane in an organism. A ray, rib, vein, or nerve in a pl. **R. vector.** A straight line joining any point in a curve with a fixed point around which the straight line turns and to which successive points in the curve may be referred.

**Radon, ch. el.** Rn. *At. no.* 86; *at. wt.* 222. *Syn.* niton.

**Radula.** The ribbon-shaped, file-like tongue of molluscs.

**Rainbow.** The arc of multi-coloured light formed by refraction and reflection of drops of water which is visible when a source of light is behind, and drops of water are in front of; an observer.

In a primary bow the red is always on the outer, the violet on the inner side; in a secondary bow this order is reversed.

**Ram-al, -ate.** *Per.* branch. Branched. Rameous.

**Ramentum.** A scaly structure on fern shoots and leaves. An elongated, membranous, or hair-like epidermal outgrowth.

**Rameous.** Ramal (*q.v.*).

**Ramicorn.** Branched antenna or horn. **Ramose.** Branched. **Ramus.** A branch. Any prominent process. A barb. A feather. A ramification. The chewing apparatus of rotifers. Vert. lower jaw.

**Ranine.** *Per.* frogs.

**Ranunculaceæ.** Fam. of pl. including buttercup.

**Raphe.** Any seam-like structure—*e.g.*, a suture, between two mericarps, a ridge on ovule. A median line—*e.g.*, of diatom valve.

**Raphides.** Minute needle-shaped crystals of calcium oxalate in cert. pl. cells (*e.g.* iris).

**Raptores.** Birds of prey. *Ex.* hawk.

**Rare earths.** Widely-distributed but very scarce oxides of the 15 els. of *at. no.* 57 to 71 inclusive and of *at. wt.* 138.92 to 175.0 inclusive. They include La, Ce, Pr, Nd, II, Sa, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu.

**Rasorial.** Adapted for scratching.

**Ratitæ.** Running, flightless birds with no keel to breast-bone. *Syn.* cursorcs. *Ex.* ostrich. *Cf.* Carinatræ.

**Rattle.** Stridulating organ at end of rattle-snake's tail consisting of eight to ten horny "bells" which fit into one another like a pile of saucers.

**Ray.** (1) An el. of infinitesimal cross-section in a beam of light. The line normal to the wave-front of an electromagnetic wave. (2) A fin-support. (3) A div. of a radiate an. (4) An insect-wing, or leaf vein, or nervure. (5) A ray-floret. (6) An elasmobranch fish.

**Reactance.** Resistance to an alternating current due to capacitance and/or inductance. **Reaction.** Reversed action. **Reflection.** Action in response to a stimulus. Entering into chemical transformation. An opposing force. Vital resistance to noxious agents. **R. time.** Time between application of a stimulus and organism's response. It varies from a fraction of a second to an hour or more. *Syn.* latent period.

**Reagent.** A substance which acts in a ch. transformation.

**Realism.** The belief that objects of sense-perception possess an *actual* objective existence independent of sensation.

**Reason.** A series of judgments the last term of which—the conclusion—is dependent upon all preceding ones.

**Recapitulation theory.** Every organism, during its developmental stages repeats *many* of

its ancestral stages—"climbs up its own genealogical tree." Ontogeny recapitulates phylogeny. Haeckel's and von Baer's biogenetic law (*q.v.*).

**Recent epoch.** Epoch since close of pleistocene. *Syn.* diluvial; holocene; human; psychozoic.

**Receptacle.** Upper central axis of flower-stalk in which flower parts are arranged. Expanded upper end of peduncle. Swollen tip of thallus. Terminal disc of mosses. Torus or thalamus of flower. Intracellular cavity. *Syn.* clinanthium; phoranthium. **Receptor.** A sense-cell, or a group of sense-cells which receives an environmental stimulus and transmits it to an effector (*q.v.*). **R., anelective.** *Syn.* nociceptor. **r.** with naked nerve-fibrils which are equally stimulated by mechanical, thermal, chemical, elec., etc., stimuli. **R., elective.** Highly specialized skin receptors with *insulated* nerve-fibrils for discrimination of contact, cold, warmth, etc., stimuli.

**Recessive.** The gene, in an allelomorph pair, whose action is obscured by its fellow *dominant* gene.

**Reciprocal hybrid.** *App.* each of two hybrids one of which is descended from the m. of one species (A) and the f. of another species (B); and the other of which is descended from a m. of the (B) species and a f. of the (A) species. **R. organs.** Organs exhibiting secondary sexual characters—e.g., large m. and small f. horns; large f. and small m. breasts.

**Reclinate.** Bent down. *Ex.* ovule suspended from funicle.

**Recoil rays.** See Canal rays.

**Rectification, elec.** Transformation of alternating into unidirectional current.

**Rectrices.** The 4 to 28 tail-feathers of birds.

**Rectum.** Terminal 6 to 8 ins. of alimentary canal.

**Red-blood corpuscles.** The coloured, hæmoglobin-containing, disc-shaped, oxygen-carrying corpuscles in blood.

After birth r.b.c.s are made by the red-marrow of bone. When first made r.b.c.s are nucleated but in mammals (except in camel) they lose their nuclei when mature. Their diameter varies: 1/360 in. (amphibians); 1/1230 in. (turtle); 1/1800 in. (swan); 1/2740 in. (elephant); 1/3100 in. (whale); 1/3200 in. (man); 1/3400 in. (chimpanzee); 1/3800 in. (mouse); 1/4400 in. (cat); 1/6300 in. (goat); 1/12,300 in. (pigmy deer).

**Red bodies.** *Retia mirabilia* (*q.v.*). **Red snow.** Snow on which has fallen a red-pigment-containing flagellate (chlamydomonadidæ). See Hæmatochrome.

**Rediæ.** Larvæ of liver-fluke. Brood-cells that develop within sporocyst of fluke (*q.v.*) while inhabiting snail. See Alternation of generations.

**Reduction.** (1) *Ch.* Deoxidation. Removal of O from a compound, or of non-metallic els. from a metallic compound. To unite with H. (2) *Bio.* Halving of the chromosome no. in meiosis (*q.v.*). See Spermatogenesis.

**Reduviids.** Predaceous hemipterous insects that suck the blood of other insects. Ova that are protected by outgrowths of the micropyle.

**Reflection.** Rebound of a wave from a surface in such

manner that the incident ray and reflected ray make the same angle with the perpendicular to the surface and are in the same plane. **Reflex, R. action.** An unconscious, automatic, motor response to a sensory impulse initiated by an environmental stimulus, the purport of which response is to enable the organism, in some particular respect, better to dominate the environment.

A neuro-muscular adjustment due to the inherited mechanism of the neuro-muscular system and directed towards some *immediate* goal. A r. concerns a *part* of an an. body, and does not even need an intact nervous system, for it will occur in decapitated an. or in their severed limbs; it is involuntary and independent of all experience. Cf. Conditioned r.; Unconditioned r.; Instinct; Tonic r.; Tropism.

**R. arc.** Route of nerve-impulses during a reflex.

The primitive mechanism is represented by the protoplasmic differentiation of a single cell (*e.g.*, amoeba) into *receptive*, *conductive*, and *effective* or *executive* parts; the specialized mechanism involves three nerve-cell elements, the *receptor*, the *connector*, and the *effector*.

**R., delayed.** Probably *all* actions, conscious and unconscious, are r. in nature. In this sense a conscious and deliberate act is a d.r., one that has been side-tracked into a long and complex route through the grey matter of the cerebral hemispheres.

**Refraction.** Bending of a wave of light, heat, sound, etc., when passing obliquely from one medium into another medium in which its vel. is different.

**Regeneration.** *Syn.* morphallaxis. Renewal of a lost part of an organism.

It is really a form of asexual reproduction. *Ex.* a complete hydra will grow out of a severed piece, a starfish will renew a lost arm, a lizard a lost tail, crab a lost claw, snail a lost eye, and the sea-cucumber its lost viscera. Man can renew portions of lost skin or nerve. *See* Holomorphism.

**Regma.** A seed-vessel with valves opening by means of elastic fibres. A schizocarp.

**Regression, filial.** Return on part of descendants of exceptional parents towards average level of the species. **R. of memory.** Disappearance, with increasing age, of memory of *recent* events with retention of memory of remote events.

This is due to the fact that dissolution of the brain takes place in the inverse order of its ev., the simple, primitive functions disappearing long after the later-developed complex ones.

**Rejuvenation, bio.** Renewed vigour of two cells following temporary conjugation with fusion and interchange of their protoplasmic contents.

**Relativity.** Dependence of one quantity or fact on another quantity or fact.

The assumption that the universe is a finite four-dimensional space-time continuum based upon such facts as: (1) a gravitational field is non-existent when observer and observed body have the same acceleration; (2) we know nothing of *absolute* length, motion, etc.; our knowledge of these is purely relative; (3) unobstructed light has a constant vel. irrespective of the relative vel. between observer and light-source; (4) the mass of matter increases with vel. and the correlative assumption that, if its vel. attained to that of light, it would be light.

**Relay.** An instrument that allows of a large amount of work being performed with very little expenditure of en-

ergy on its own part. *Ex.* thermionic valve.

**Reluctance.** Magnetic resistance. Ratio of magnetomotive force to magnetic flux.

**Remanence.** Residual magnetism.

**Remiges.** Quill feathers of wing.

**Remiped.** Having feet adapted for scratching.

**Renal.** *Per.* kidneys.

**Rennet.** Lining membrane of fourth stomach of ruminants.

**Repend.** *App.* leaf with crenated edge.

**Repent.** Creeping; prostrate.

**Replete.** An ant capable of distending its crop with honeydew so that it acts as a food storage-chamber from which other ants draw their sustenance.

**Reproduction.** Process of multiplication of living units—a main feature differentiating living from not-living matter.

*r.* may be asexual (cell-fission, sporulation, budding, grafting, runners, bulbs, tubers, suckers, cuttings, etc.) or sexual—*i.e.*, by fusion of two individuals and their subsequent fission, or by the shedding of specialized cells each one of which, by fusion with a correspondingly specialized cell from another individual or from another part of the same individual, can initiate a new being. *See* Amphimixis; Sporiparity; Gamete; Parthenogenesis; Ova; Spermatozoa.

**Reptiles.** *Cl.* of cold-blooded, air-breathing verts. with (as a rule) three-chambered hearts. About 5000 species. *Ex.* snake.

**Resilience.** Elasticity. The work a body is capable of doing in recovering its original form after removal of a deforming stress.

**Resistance, elec.** Opposition to flow of electrons due to repelling effect of the planetary electrons of the atoms of the conductor. The reciprocal of *conductance*. The unit of *r.* allows unit E.M.F. to produce unit current. **Resistivity.** Capacity for resistance (*q.v.*); it is the reciprocal of *conductivity*. The resistance to a current per unit vol. expressed in microhms. *Sp.* resistance.

**Resonance.** The setting, by a vibrating system, of a non-vibrating system into a state of vibration. **Intensification** of sound by supplementary vibrations. *Elec.* The flow through two circuits of currents of same freq. **R. potential.** Voltage necessary to shift a planetary electron from its normal to its next nearest orbit. **R. radiation.** In fluorescence (*q.v.*), the fluorescent radiation has, as a rule, a longer w.-l. than the w.-l. of the inciting radiation. Rarely, waves of same length as those of inciting radiation are present among the fluorescent rays and these are termed *r. radiations*.

**Respiration.** Process of breathing—*i.e.*, taking in oxygen and expelling CO<sub>2</sub>. **Inspiration** *plus* expiration. Essentially, a gaseous interchange. *See* Aerobe; Anaerobe. **R., accessory organs of.** Air-bladder of cert. fish; intestine of loach; branchial outgrowths of climbing-perch; tail of periphthalmus; anal sacs of water-tortoise, etc. **Respiratory pigment.** Hemoglobin. Hemocyanin. Hemocerythrin. Hemofuscin. Cytochrome. Chlorophyll. Erythrophyll, etc. **R. quotient.**

Ratio of vol. of  $\text{CO}_2$  evolved and O absorbed. *Ex.* in seeds with much starch  $\text{r.q.} = \text{CO}_2/\text{O}_2 = 1$ . In seeds with much oil  $\text{r.q.} = \text{CO}_2/\text{O}_2 =$  less than unity.

Resting eggs. Winter eggs (*q.v.*).

Retia mirabilia. Red bodies. Red glands. A dense network of capillary blood-vessels in cert. fish and aquatic mammals (whales) which probably function as a reserve of O.

Reticulum. Second chamber of ruminant stomach. A mitome. A protoplasmic network. Network at base of petiole in palms.

Retina. The sensitive nervous network at back of eye which receives light impressions. Its essential sensory layer is that containing the rods and cones (*q.v.*). See Telencephalon.

Retinaculum. A gland-like organ. A hook-like structure —*e.g.*, funicle of seed; support of cirriped egg-sac; wing-connector of insects. See Frenulum.

Retrograde evolution. Retrogression of organization and assumption of characters of a lower type in an organism as it approaches maturity. *Ex.* ascidian. See Reversed selection.

Retrorse. Bent backwards.

Refuse. Having a notched, obtuse apex.

Reversed line. Dark absorption line in spectrum. See Reversing layer. R. selection. A reversal, not of the process, but of the results of natural selection, consequent on opposed conditions such as the change of formerly useful

organs into useless or dangerous ones. *Ex.* production of wingless beetles on oceanic islands. Reversible reaction. A ch. reaction which, according to conditions, can take place in either direction. *Ex.*  $\text{Hg}_2 + \text{O}_2 \rightleftharpoons 2\text{HgO}$ —*i.e.*, mercury heated with oxygen forms the oxide of mercury,  $\text{HgO}$ , and this, further heated, breaks up into  $\text{Hg}_2$  and  $\text{O}_2$ . See Irreversible. Reversing layer. Gaseous layer, 700 miles thick, above photosphere but below chromosphere of sun. It contains most of the els., and is the cause of the absorption producing *Fraunhofer lines*. See Reversed line. Reversion. Sudden appearance in an offspring of a long-concealed character. Return to ancestral type. Atavism. Throw-back.

Revolution. Movement in an orbit around a centre or focus. *Ex.* the earth revolves about sun in an elliptic orbit. See Kepler's law. Often used (incorrectly) as a *syn.* for rotation (*q.v.*).

Rhabdites. Short, refractive, rod-like structures in cert. worms. Part of ovipositor. A gonapophysis. Rhabdoid. Rod-shaped. Rhabdolith. A calcareous supporting rod. A coccolith. Rhabdom. Rod-like structure in retinule of ommatidia. Rhabdopod. Clasper. Rhabdophore. A collection of rhabdoliths. A coccolith.

Rhamphoid. Beak-shaped. Rhamphotheca. Horny sheath of beak. See Cere.

Rhenium, *ch. el.* Re. Metal. *At. no.* 75; *at. wt.* 186.31.

Rheophile. Living in, on, or



near streams. **Rheophore.** A current-carrying wire. An electrode. **Rheostat, elec.** A resistance-controller. **Rheotaxis, Rheotropism, zoo.** Reaction (by orientation) to currents (air or water). *Ex.* fish head up-stream. **Spermatozoa swim** against current.

**Rhinencephalon.** Olfactory lobe of brain. **Rhinophores.** Olfactory tentaculoids in molluscs.

**Rhipidium.** A fan-shaped zooid or inflorescence.

**Rhizanthous.** With flowers arising from root. **Rhizantous.** Having rhizoid-connected antheridial and archegonial branches. **Rhizocarpous.** Having perennial underground and annual above-ground parts. **Rhizocorm.** A juicy, corm-like rhizome. A bulb. **Rhizoid.** Root-like, yet not a true root. *Ex.* root-filaments of thallophytes. Anchoring (and absorptive) threads of prothallus. **Rhizome.** Root-stalk. A thick, partly-buried, horizontally-creeping stem which sends shoots upwards and true roots downwards.

**Rhizomorph.** Root-like hyphæ. **Rhizophore.** A naked branch, intermediate in structure between a stem and a root, which grows down into the soil, and then produces roots proper. **Rhizoplast.** A thread, in cert. flagellates, joining blepharoplast to nucleus. **Rhizopods.** A div. of protozoa including amœba.

**Rhodium, ch. el.** Rd. Metal. *At. no.* 45; *at. wt.* 102.91.

**Rhodocyte.** A red blood-corpuscle. **Rhodophane.** Red pigment in retinal cones of

cert. animals. **Rhodophyll.** Red pigment in algæ. **Rhodopsin.** Visual purple (*q.v.*).

**Rhombencephalon.** The hind-brain.

**Rhombus.** An equilateral, oblique-angled parallelogram.

**Rhopalia.** Marginal sense-organs in jelly-fish.

**Rhynchocephalia.** Ancient O. of reptiles with sphenodon the sole survivor. **Rhynchodont.** Having a toothed beak. **Rhythmometer.** Chordotonal organ.

**Rib.** (1) One of paired supporting bones of sides of body of verts.

The normal no. of ribs in man and orang is 12 pairs, in gorilla and chimpanzee 13 pairs, and in gibbon 13 or 14 pairs. This normal no. may be increased or diminished in either sex in any of these primates. Most lower vertebrates, notably fish, have a much larger no. of ribs. Vestiges of such additional ribs attached to lumbar and sacral vertebrae are present in the human embryo.

(2) Central leaf-vein. **R., false or floating.** A rib the ventral end of which does not join the breastbone.

**Rictus.** Throat of bird or corolla. Gape.

**Rigor.** Rigid state of an. or insensitive state of pl. **R. mortis.** Rigidity (due to myosin) of muscles after death and lasting until putrefaction sets in.

**Rimose.** Fissured.

**Ring-canal.** A ring-shaped tube in echinoderms and cœlenterates through which fluids circulate.

**Ringent.** *App.* widely separated petals or shells.

**Rivose.** Sinuously furrowed.

**Rodents.** O. of gnawing mammals with chisel-like

teeth. *Ex.* rat; squirrel; rabbit.

**Rods and cones.** Els. of retinal nerve-cells. Rods contain the visual purple (*q.v.*) and subserve faint-light vision; they are about 3,000,000 in no. The cones are fewer and subserve discriminating and colour vision.

**Root.** Part of a pl. which usually, but not invariably, grows underground, anchors the pl., and conveys water, salts, etc., to it. A quantity which, taken as a factor a no. of times (shown by an index), produces another quantity; the correlative to "root" is "power." **R.**, adventitious. A r. that grows from an unusual part. A crampon. **R.-apex.** Growing point of a r. which is protected by a **R. cap.** or pileorhiza. *See* Calyp-trogen. **R.-hairs.** Delicate, unicellular, extensions of pili-ferous layer just behind the r.-apex with an absorptive function. **R. nodule.** *Syn.* r. tubercle (*q.v.*). **R. pressure.** The force which compels water to rise through axial stele of a pl. to all parts and which, in spring, causes the "bleeding" of a cut stem. **R. tuber.** R. modified for food-storage. **R. tubercle.** *Syn.* r. nodule. A swelling around r.-hairs of legumes caused by, and containing, colonies of symbiotic nitrogen-fixing bacteria which pass on complex nitrogenous compounds to the plant.

**Rostellum.** Any beak-like process. The sucking proboscis of lice and tape-worms. Cement-gland of orchid.

**Rostrum.** A beak or snout

or other pointed organ. A projecting process between eyes of crustaceans.

**Rot.** (1) Decomposition. (2) Trematode infection in sheep.

**Rotation.** Turning about an axis. *Cf.* Revolution. Circulation of cell-sap. Serial change of crops. **R. of earth,** proofs of. (1) Apparent revolution of stars could not be actual, because the stupendous vels. required are not possible for matter. (2) The stars being at variable distances, their movements around earth should be variable, instead of, as is the case with their apparent movement, uniformly one revolution each 24 hrs. (3) The shape of the earth—an oblate spheroid—is incompatible with absence of r. but compatible with its existence. (4) Telescope reveals r. in the sun and other planets. (5) A dropped stone deviates 0.35 in. to the E. in 250 vertical ft. fall. (6) The plane of oscillation of a pendulum would be fixed relative to surface objects in absence of r., whereas the plane *seems* to turn to the right in the N., and to the left in the S. hemisphere. (7) The rate of change of the plane of a pendulum's swing decreases from a max. at equator towards either pole. (8) The axis of a gyroscope pointed at a star changes its relation to objects on the earth. (9) The N.E. and S.E. trade winds are compatible with an equator rotating from W. to E. **Rotatoria, Rotifers.** Wheel-animalcules. A *Cl.* of worms. There are 850 species (*q.v.*) of rotifers.

**Rubidium**, *ch. el.* Rb. Metal. *At. no.* 37; *at. wt.* 85.440.

**Rubiginous**. Rust-coloured. Infected with rust (*q.v.*).

**Ruderal**. Growing on waste land.

**Rudi-ment, -mentary organ**. An organ but imperfectly developed or formed. A vestige. An anlage.

A structure that fails to attain complete development owing to some germinal defect or failure of nutrition. More strictly a *r.* is in process of ev. and is therefore progressive, whereas a *vestige* is retrogressive, tending to diminution and ultimate disappearance. In this sense the small horns of ancestral ungulates are *rudimentary*, while the splint-bones of modern horses are *vestigial*. *Ex.* of *r.* organs are: man's external-ear and tail muscles; gill arches and clefts of mammals; whalebone whale's teeth; ostrich's and kiwi's wings.

**Rumen**. Paunch; the first chamber of ruminant's stomach. **Ruminants**. Group of even-toed, divided-hoofed, horned (as a rule) mammals which "chew the cud" and are destitute of front teeth in upper jaw. *Ex.* sheep; deer; oxen. **Ruminate**, *zoo.* To

"chew the cud"—i.e., to chew again and thoroughly insalivate what had been regurgitated from the first stomach after a perfunctory chewing and salivation. *Bot.* Mottled.

**Runcinate**. Pinnate, with downward-pointing divs.

**Runner**. A long axial stem which, after growing over surface of the ground, sends adventitious roots downwards and leaves upwards. *Ex.* strawberry. *Syn.* stolon; soboles.

**Rupestrial**. *Per.* or composed of rock. **Rupicolous**. Living on, or among, or obtaining nourishment from, rock. *Ex.* lichen.

**Ruptile**. Dehiscing, or bursting, irregularly.

**Rust**. (1) *Ch.* Reddish iron oxides and carbonates. (2) *Bio.* Parasitic fungi (*ex.* basidiomycetes) the mycelium of which invades higher pl. tissues (*e.g.*, wheat).

**Rut**. (Estrus. The sex urge. Heat (*q.v.*).

**Ruthenium**, *ch. el.* Ru. Metal. *At. no.* 44; *at. wt.* 101.7.

## S

**Sabre-tooth**. Extinct tiger-like an. with long canines; their probable ancestor was *hoplophoneus*. *Ex.* *machærodus*.

**Sabuline, sabul-ose, -ous**. Sandy; arenaceous.

**Sac, Saccate**. Any sac or pouch-like structure. **Gibbous**. Encysted.

**Saccharin**. (1)  $C_6H_5O_5$ , a bitter, crystalline derivative of toluene. (2)  $C_7H_5O_3NS$ , also

from toluene, a sugar-substitute 400 times sweeter than sucrose. **Saccharomycetes**. A fungus-yeast. **Saccharose**. Sucrose (*q.v.*).

**Sacci-ferous, -form**. Bearing, or like, a sac or pouch.

**Saccule**. A small sac. Part of larynx and vestibule. **Sacculina**. A degenerate cirripedian which bores into body of m. crab and effects "parasitic castration" (*q.v.*) by

destroying the testes which sometimes are replaced by ova-producing ovaries.

**Sacral.** *Per. Sacrum.* Composite bone forming part of hip-girdle made up of fused vertebrae (five in man).

**Sadism.** Stimulation of sexual instinct by infliction of pain or degradation on the partner. *Opp. masochism.*

**Safety lamp.** Lamp in which flame is enclosed by a wire gauze which prevents it passing outwards and so igniting any inflammable gases. **Safety-valve.** Automatically-acting valve adjusted to lift or open to a cert. pressure.

**Sagittal; Sagittale.** Resembling, or in direction of, arrow. *App.* axis or section in median longitudinal plane. *Ex. s.* suture of skull. *App.* arrow-shaped leaves.

**Sago.** Pith of palm.

**Saint Elmo's Fire.** Brush-discharge of elec. from prominent points; if red, +; if blue, —.

**Salamander.** Lizard-like amphibian. *Ex. newt.*

**Sal ammoniac.** Ammonium chloride.  $\text{NH}_4\text{Cl}$ .

**Salicin.** Crystalline glucoside of willows,  $\text{C}_{13}\text{H}_{18}\text{O}_7$ .

**Salicylates.** Salts of salicylic acid,  $\text{C}_7\text{H}_6\text{O}_3$  derived from pl., fruits, and phenol.

**Saliva.** Spit. Digestive fluid containing a ferment *ptyalin* secreted in mouth by three pairs of Salivary glands, the parotid, submaxillary, and sublingual.

**Salsuginous.** Growing in salty soil.

**Salt.** (1) A compound (*ex.* sodium chloride,  $\text{NaCl}$ ) in which all or part of hydrogen of an

acid (*ex.*  $\text{HCl}$ ) has been replaced by a radical, metal, or el. (*ex.*  $\text{Na}$ ). Common s. is a mixture of many salts, principal of which is  $\text{NaCl}$ . (2) An electrolyte (*q.v.*) which is neither acid nor base. **S. of lemon.** Potassium oxalate. **S., rock.** Common salt obtained by mining; it is often coloured red by iron.

**Saltation.** Abrupt deviation from normal; discontinuous variation. *Mutation (q.v.).* Sport. **Salt-atorial, -igrade.** Having limbs adapted for leaping. *Ex. flea; grass-hopper.*

**Saltpetre.** (1) Nitrate, of potassium ( $\text{KNO}_3$ ), of sodium ( $\text{NaNO}_3$ ), and of calcium, ( $\text{Ca}(\text{NO}_3)_2$ ). (2) Rock salt.

**Samara.** Winged, indehiscent seed. See Fruit. *Ex. sycamore.*

**Samarium, ch. el.** Sm (Sa). Metal. *At. no.* 62; *at. wt.* 150.43.

**Sand.** Small particles (0.6–0.06 in. d.) of disintegrated rock, mostly quartz. Above 0.6 in. d. sand merges into pebbles, below 0.06 in. d., into silt. **S.-fly.** The disease-incubating fly *Phlebotomus*. **S.-hoppers.** Small sea-shore crustaceans with laterally-flattened bodies. Beach-fleas. **S.-stone.** Sedimentary rock, mostly of quartz grains cemented by silica, calcium carbonate, iron oxide, etc.

**Sanguicolous.** Living in, and on, blood. **Sanguivorous.** Living on blood. **Sanguisugous.** Blood-sucking.

**Santonin.** Crystalline compound ( $\text{C}_{15}\text{H}_{18}\text{O}_3$ ) of worm-wood, *artemisia* (vermifuge).

**Sap.** Watery fluid circulating in vascular pl.-tissues con-

taining salts, proteins, and carbohydrates. **S. wood.** Alburnum, the younger wood as *cf.* c. heart-wood.

**Saponify.** Hydrolysis by alkalis of fats and oils into soap (*q.v.*).

**Saprogen-ic, -ous.** Causing putrefaction. **Sapropelic.** Living in mud. **Saprophagous.** Feeding on putrid matter.

**Saprophilous.** Saprophytic. **Saprophyte.** Organism living on decaying remains of other organisms. *Ex.* fungus. *Cf.* Autophyte. **Saprophytic.** *Per.* saprophyte. **Saprophilous.**

**Holozoic (q.v.). Saprozoic.** Living on decomposing protozooids.

**Sarcenchyma.** Parenchyma with scanty ground-substance.

**Sarcina.** Bacteria which, on div., form cube-like masses.

**Sarcocarp.** Fleishy part of fruit; pulpy mesocarp. **Sarcocyte.** Clear middle layer of ectoplasm of sporozoa. **Sarcode.** Primitive type of protoplasm. **Sarcoderm.** Primitive fleshy layer of seed. **Sarcosperm.** **Sarcodictyum.** Reticulated protoplasm. **Sarcodina.** *Cl.* of protozoa characterized by pseudopodia (*amoebæ; radiolaria; foraminifera*).

**Sarcogenic.** Flesh-producing. **Sarcoid.** Flesh-like. **Sarcolemma.** Tubular sheath of striated muscle-fibre. **Sarcoma.** Type of malignant growth. **Sarcophagous.** Carnivorous. **Sarcoplasm.** Clear, intra-reticular muscle protoplasm. **Sarcoptes.** Itch-mite. **Sarcosoma.** Protoplasm as *cf.* c. skeletal framework. **Sarcosperm.** **Sarcoderm (q.v.). Sarcostyle.** Muscle fibril. **Dactylozoid** or its column. **Sar-**

**cotesta.** Fleishy part of test. **Sarcotheca.** Sheath of sarcostyle. **Sarcous.** *Per.* flesh, muscle, or protoplasm. **Sarkin.** Spermatuminoid.

**Sarment-aceous, -ose, -ous.** Having prostrate runners, stems, or branches. **Sarmentum.** Prostrate stem.

**Sarothrum.** Pollen-brush.

**Sartorius.** Muscle of thigh and longest in human body; it rotates leg when adopting a tailor's attitude.

**Satellite.** Attendant body to, and revolving about, a planet.

**Saturation.** (1) Absorption by a body of max. possible amount of another substance. The taking up by a liquid of max. amount of a soluble substance, or, conversely, the taking up by a substance of max. quantity of a liquid.

In a *saturated solution* the liquid has dissolved as much of the substance as is possible at a given temp. and p. *See* Supersaturation. (2) Max. absorption of water-vapour per unit vol. of air at given temp. (3) Max. quantity of magnetic flux in a magnetizable body. (4) Condition of electron-tube when increased voltage produces no increase of current.

**S. pressure.** The p. of a vapour that is in equilibrium with its liquid. Max. possible p. by a vapour at given temp.

**Saurians.** Lizard-like reptiles, especially such ancient types as dino-, ichthyo-, and plesio-saurians. **Saurischia.** O. of extinct reptiles including cert. dinosaurs. **Sauropoda.** S.O. of *saurischia*. *Ex.* diplodocus. **Sauropsida.** Group of amniotes, including birds and reptiles.

**Savis's vesicles.** Deep-sunk pit-organs of electric ray.

**Sawfly.** Leaf-cutting hymenopter.

**Saxicavous.** Rock-boring.  
*Ex.* cert. molluscs. **Saxicoline.**  
Dwelling amid rocks.

**Scabies.** Itch disease caused by (female) mites.

**Scabe-rate, -rescent, -rulous.**  
Rough, scurfy, scaly, corrugated.

**Scala.** One or other of three ladder-like canals in cochlea.

**Scalar.** (1) Ladder-like. (2) Fully describable by a no., or by a point, on a scale. An *undirected* quantity or magnitude—*e.g.*, *mass*, *time*. *Syn.*

**Scalariform.** Scalar (*q.v.*); *app.* type of algal conjugation.

**Scale.** (1) Plate-like, horny, or bony formation in skin. Bract. Ligule. Modified hair. Squama, -ella, -ula. Tegula. Palea. Cataphyllary leaf. *Scale-leaf.* Sporophyll of *pinus*; one of colourless "leaves" of rhizome; bud-protecting leaf. (2) Dish of balance. (3) Anything graduated for measuring purposes.

**Scalene.** Uneven. Unequal. *App.* triangle with unequal angles and sides, or to an axis inclined to base.

**Scalp.** Hair, skin, and subcutaneous tissues covering dome of skull.

**Scalpella.** Paired piercing and sucking processes in proboscis of bugs and flies. **Scalpriform.** Chisel-shaped.

**Scandent.** Climbing.

**Scandium, ch. el.** Sc. Metal. *At. no.* 21; *at. wt.* 45.10.

**Scansorial.** Climbing. Arboreal.

**Scape.** Root peduncle. Peduncle of "balancer"; two basal segments of flies' antennæ. Base of polyp. Stem, shaft, calamus.

**Scapha.** Boat-shaped de-

pression. **Scaphium.** Part of copulatory apparatus of m. butterfly. **Scaphocephal-ic, -y.** Having boat-shaped skull—*i.e.*, one narrowed laterally and elongated antero-posteriorly. **Dolichocephaly** (*q.v.*). **Scaphoid.** Boat-shaped. *Ex.* scaphoid bone (centrale) in carpus and tarsus.

**Scaphopoda.** *Cl.* of molluscs. **Scapi-form, -oid, -ose.** Scape-like.

**Scapula.** Shoulder-blade; also parts of an. that resemble it—tegula, patagium, mesothoracic pleuron, parapteron, etc. **Scapulars.** Feathers overlying bird's scapulæ.

**Scarab.** Egyptian dung-rolling beetle.

**Scari-ose, -ous.** Dry, shrivelled, membranous.

**Scatophagous.** Stercororous (*q.v.*).

**Schindylesis.** Joint in which a flat bony process fits into a cleft in adjacent bone.

**Schistocyte.** Small red corpuscle.

**Schizocarp.** Fruit with pericarp formed from a syncarpous gynoecium which, when ripe, divides into many indehiscent one-seeded carpels (cocci). *See* Fruit; Cremocarp. **Schizocroal.** Having grouped simple eyes each with separate biconvex lens and cornea. *Ex.* trilobite. **Schizocœl-ic, -ous.** Having coelom formed by splitting of mesoblast into layers. **Schizogamy.** Fission with production of sexual and asexual zooids. **Schizogenesis.** (1) Reproduction by fission. *Syn.* schizo-, agamo-gony. (2) Formation of spaces by delamination of adjacent cell-walls. **Schizokinete.** Motile phase of

**haemosporidia.** Schizomycetes. **Bacteria.** Schizont. Mature trophozoite stage of sporozoon before its multiple fission into merozoites. *Syn.* agamont. **Schizontoblast.** Cytomere. **Schizontocyte.** Cytomere of divided schizont which itself divides into merozoites. **Schizophasia.** Mental disorder characterized by incoherence of speech. **Schizophrenia.** A mental disease of comparative youth in which the victim loses touch with his environment and in which the normal single personality becomes "split" into dual personalities of the Jekyll and Hyde type, sometimes into multiple degenerate personalities. **Schizophyceae.** Cyanophyceae. **Schizophytes.** Fission-plants—*bacteria, cyanophyceae*. **Schizopoda.** (1) O. of crustacea. (2) Stage of development of decapod larvae. **Schizostely.** Stem wherein plerome produces several strands, each representing one vascular bundle. *Syn.* astely. **Schizothecal.** With scale-like tarsal plates. **Schizozoite.** Merozoite from a segment of a dividing schizont.

**Sciatic.** *Per.* hip or to sciatic nerve.

**Science.** Organized knowledge—especially as a field of research.

**Scintillation.** Emission of flashes. Discrete speck of light produced in a screen by impact of high-speed subatoms.

**Scion.** Cut-off bud-containing portion of pl. attached to another pl. for propagation. *Syn.* cion; graft. *See* Stock; Budding.

**Sciophilous.** Shade-loving.

**Sciophyte.** Pl. that thrives in shade. **Scioptic.** *Per.* subjective images formed in darkness.

**Scirrhus.** Indurated. Cancerous.

**Sclera.** Sclerotic (*q.v.*). **Sclere.** Skeletal spicule in sponges. **Sclereid.** Stone-cell. **Sclerotic cell.** Thick-walled cell of Sclerenchyma. **Hard,** lignified, and often mineralized, supporting tissue of cortex, phloem, and seeds. **Skeletal part of corals.** *See* Sclereid. **Sclerite.** Calcareous plate or spicule. **Scleroblast.** Sclere-forming cell. **Dentine- and scale-forming cell in fishes.** **Sclerocauly.** Tough-stemmed. Excessive formation of sclerenchyma in desert plants. **Scleroderma.** (1) Indurated skin; tough exo-skeletal material. (2) Genus of fungi. **Sclerogen.** Lignified or mineralized cell-walls. **Scleroid.** **Hard.** **Skeletal.** **Sclerophyllous.** Excess of sclerenchyma in leaves, as in desert pl. **Sclerosis.** Induration. Excess of connective tissue, lignin, etc. **Sclerot-al, -ic.** (1) Sclerous, hard, indurated, lignified. (2) Capsule of eyeball continuous *c.* cornea in front, *c.* optic-nerve sheath and *dura mater* behind. *Syn.* sclera. In lower verts. the sclerotic contains bony-plates called sclerotic ossicles. **S. ossicles.** *See* Sclerotic. **Sclerotium.** (1) Hard, wax-like mycelium of fungi. (2) Hard, waxy plasmodium of *myxomycetes*. (3) Ergot of rye. **Sclerotome.** Primordial skeletal tissue of somite (*q.v.*). **Sclerous.** Sclerotic (*q.v.*).

**Scole-cid, -ciform, -coid.** *Per.* Scolex. Head of larval

(bladder-worm), or of adult, tape-worm. Scolite. Fossilized worm-burrow.

**Scolopale.** Rod-shaped sense-organ of insects, the sensitive el. of Scolophore. Nerve-end-organ of hearing apparatus in insects. It contains the scolopale. See Chordotonal organ.

**Scopa.** Pollen-brush. **Scopate, -iferous, -iform.** Hairy. Brush-like. **Scopulate, -liferous, -liform.** Scopula. Hairy tuft or brush-like organ. **Scopulate, -liferous, -liform.** Scopate (*q.v.*).

**Scorpioid, -al.** Circinate. Curved at end like a scorpion. *App.* uniparous, cymose, inflorescence (borage). *Syn.* cincinnus. *Cf.* Helicoid.

**Scotoma.** Dark spot in visual field.

**Screw.** A cylindrical axis from which projects a continuous helical rib or "thread" (m. s.); corresponding part into which m. s. is inserted (f. s.). **S. pitch.** Distance between two adjacent threads. **S. thread.** Helical projection from m. s., or trough of f. s.

**Scrobiculate.** Pitted.

**Scrotal.** *Per.* Scrotum. External pouch which lodges the testes.

**Scruple.** 20 grains. 0.0457143 oz. av. 0.041667 oz. tr. 1.2959 grammes.

**Scutate.** Having scutes. Scutiferous. Scute. Scutum. Scale. Elytron. A shield-like plate. Mid-sclerite of insect notum. **Scutella.** One of the scaly plates over metatarsus of birds. Dermal ossicle. Any shield-like structure. Post. part of notum. Part of cotyledon separating embryo from

endosperm. Scutellum; small scute. **Scutellate.** Scaly. **Scutellation.** Scale arrangement. **Scutellum.** Scutella. **Scuti-ferous, -form, -gerous.** Having or resembling a shield or scales. **Scutate. Scutum. Scute.**

**Scypha.** Scyphus. **Scyphate, -iferous, -iform.** Cup-shaped. Having cup-like organs (*ex.* lichen). **Scyphose.** **Scyphistoma.** Polyp stage in scyphozoa. **Scyphula.** **Scyphomedusæ.** **Scyphozoa.** **Scyphose. Scyphate. Scyphozoa.** *Sub-cl.* of coelenterates. Each starts life as a polyp called **Scyphula.** **Scyphistoma** (*q.v.*). **Scyphulus, Scyphus.** Any cup-like structure. Vaginata of liverwort; "cup" of podetium in lichen. Funnel-shaped corolla. **Scypha.**

**Sea-anemone.** S.-polyp; one of the anthozoa. **S.-cucumber.** S.-slug, a holothurian. **S.-hedgehog. S.-urchin.** An echinoderm. **S.-horse.** The fish *hippocampus*. **S.-lily.** A stalked crinoid. **S.-mat.** *Flustra*, a polyzoan. **S.-mile.** Minute of arc at equator; 1:1516 mile (*q.v.*). **S.-mouse.** *Aphrodite*, an annelid. **S.-purse.** Horny egg-case of sharks and skates. **S.-slug.** S.-cucumber. **S.-squirt.** Ascidian. **S.-urchin.** S.-hedgehog, an echinoderm. **S.-weed.** Marine algæ.

**Sebaceous cyst.** Blocked and distended sebaceous gland. **S. glands.** Oil-secreting skin-glands. **Sebiferous.** Containing fatty matter. **Sebum.** Contents (oil and iso-cholesterin) of sebaceous glands.

**Secant.** Cutting, incising. (1) Straight line drawn from



centre of circle through one end of a circular arc to a tangent from other end. (2) Ratio of this line to radius.

**Secodont.** Having cutting teeth.

**Secondaries.** Six to thirty odd wing-quills (remiges, *q.v.*) on bird's ulna. Cubitals.

**Secondary.** (1) Mesozoic period between tertiary above and primary below; includes cretaceous, jurassic, and triassic. (2) Fore-arm, or one of its quills, of bird. **S. battery.** Accumulator (*q.v.*). **S. sex character.** Character that, while indirectly concerned with procreation, differentiates sex. Such characters are coloration, hair, horns, spurs, crests, wattles, plumes, scent-glands, voice, size, strength, etc.

**Secretin.** Hormone produced in intestine which, carried to pancreas, causes it to secrete pancreatic juices.

**Secretion.** (1) Substance elaborated by a gland out of blood or body-fluids. (2) Process of such elaboration. **S., organs of external.** Glands with ducts. *Ex.* gastric, hepatic, pancreatic, renal, salivary, sebaceous, and sweat glands. **S., organs of internal.** Ductless or endocrine glands (*q.v.*) including adrenal, ovary, parathyroid, pineal, pituitary, testis, thyroid, and thymus.

**Sectile.** Div. by partitions.

**Sector.** Figure contained by two radii and intercepted arc.

**Sectorial.** Cutting; carnassial.

**Secund, secundiflorous.** Unilateral disposition as in cert. flowers. **Secundine.** (1) Coat of ovule investing nucellus and lying inside primine. (2) Fœtal membranes.

**Sedimentary rocks.** Limestone, conglomerate, sandstone, shale, gypsum, rock-salt, etc., deposited as sediment under, or from solution in, water.

**Seed, bot.** Fertilized ripe ovule. Embryo-sac. **Zoo.** Semen, sperm, milt. **S.-leaf.** Cotyledon.

**Segment.** Part of an an., of a jointed limb, of a cleavage cell, or of a leaf. Transverse ring of articulata. Metamere. Somite. **Segmentation.** Div. into parts as in developing ovum. Formation of many cells from one. *Syn.* cleavage; merogenesis; metamerism. *See* Formative material; Holo-, Mero-blastic; Somite. **S. cavity.** Central space in blastula. Blasto-, Lecithocœl. **S. nucleus.** Conjoined m. and f. nuclei in zygote. **S. sphere.** Blast-omere, -ula.

**Seismic.** *Per.* earthquakes. **Seismograph.** Earthquake-registering apparatus. **Seismonastic.** *App.* response of organisms to mechanical stimuli.

**Selachii.** S.-O. of elasmobranchs. Sharks.

**Selection.** Processes, *artificial* or *natural*, which allow cert. individuals to survive, and prevent cert. other individuals breeding.

**Selenium, ch. el.** Se. Metalloid. *At. no.* 34; *at. wt.* 78.96. **S. cell.** An arrangement depending on the facts that in the dark Se is a poor conductor of elec.; in strong light a good conductor.

**Selenodont.** Having teeth with *crescentic* crown-ridges. **Selenotropism.** Phototropism to moonlight.

**Self-fertilization.** Transference in one flower of pollen

from anther to stigma. Fertilization of the ova of an an. by its own sperm. *Syn.* self-pollination; auto-gamy, -gony. *See* Cleisto-, Dicho-gamy. **Self-inductance.** Coefficient of *self-induction*. E.M.F. induced in a conductor over and above the applied E.M.F.

**Sematic.** Having conspicuous colour (or smell) for warning purposes. *Cf.* Cryptic.

**Semen.** Seed. Fluid of m. an. containing fertilizing spermatozoa.

**Semicircular canals.** Three half-circle-shaped, bony-membranous tubes in internal ear of verts., each in a plane at right angles to that of either of the other two. They are concerned in maintaining equilibrium. Most fishes and higher an. have three s.c., *petromyzon* has two, *myxine* has only one.

**Seminal receptacle.** Sac-shaped organ in which m. reproductive els. are stored till required for fertilization. S. vesicle. S. sac. Spermatheca. **Seminiferous.** Bearing seeds or semen.

**Sensation.** Feeling. What it is in essence is not known beyond that it depends on change and relationship and possesses quality, intensity, duration, and extent, and that it is the subjective end-result of the stimulation of a sense-organ (receptor) by an environmental impact. *Æsthesis.* **Sense-organ.** A mechanism that arrests external physical modes of motion (light, heat, etc.) and converts them into nervous impulses (*q.v.*) which, reaching a nerve-centre (brain), there evoke corresponding *sensation* (*q. v.*). *Ex.* eye;

ear; nose; touch-body; taste-bud; otolith organ; lateral line; sensilla; halteres; Johnstone's-organ; sphæridia; etc. **S.-rod.** Scolopale. **Sensill-a, -um, -us.** Sense-organ. **Sensitivity.** (1) Capacity to experience sensation—to receive and respond to external influences. *Ex.* slime-mould moves towards dead leaves, away from salt; spermatozoon moves towards unfertilized, away from fertilized, ovum; a phagocyte moves towards a microbe. (2) The definition cannot strictly exclude the inorganic world. Selenium and salts of silver are sensitive to light, a magnet to an electric field, a thermopile to temp. changes, metals to alternating stresses. *Cf.* Irritability. *See* Fatigue of metals. **Sensorium.** (1) Brain. (2) Parts of brain subserving sensation and consciousness. (3) Sense-organs and their nerve-centres. **Sensory.** *Per.* sensation. *App.* nerves carrying impulses to sensorium. *Afferent.* *Cf.* Efferent.

**Sepal.** One of the modified leaves which form a calyx, **Sepalody.** Change of petals, or other floral parts, into sepals.

**Sepia.** Cuttlefish—a decapod ink-squirting cephalopod.

**Sepicolous.** Inhabiting hed-ges.

**Sepsis.** Contaminated by pathogenic bacteria. **Septicæmia.** Poisoning by pathogenic micro-organisms.

**Sept-al, -ate.** Partitioned. **Septum.** Partition.

**Sequestrum.** A separated and dead piece of bone.

**Seric-ate, -eous.** Covered with fine hairs.

**Serolemma.** Membrane which, with the amnion, envelops foetus of reptiles, birds, and mammals. **Serosa.** Serous membrane. False amnion. **Blastodermic** membrane of insects. **Serotinous.** Blossoming late. **Serous.** *Per.* serum or to lining membrane of joints, heart, lungs, abdomen, etc.

**Serpulite.** Fossilized worm-tube.

**Serr-ate, -iform, -ulate.** Notched. Toothed. Saw-like.

**Sertoli cells.** Striated cells in tubules of testis which nourish the spermatids; their homologues in the ovary are cells of *stratum granulosum* in Graafian follicle. *Syn.* nurse-cells. Also *app.* spermatoblasts (*q.v.*).

**Serum.** Liquid that separates out from clotting blood.

**Sesamoid.** Bone developed in tendon where it passes a joint.

**Sessile.** Without stalk. Attached directly on a base.

**Seta.** Bristle-like structure. **Chaeta.** See Epibasal. **Setaceous, -iferous, -iform-, -iparous, -ose.** *Per.* seta. Bristly. **Trichoid.** Having stiff hairs or fine teeth. **Setula.** Slender seta.

**Sex.** Condition of maleness or femaleness. Sum of characteristics, structures, functions, making an an. or pl. a m. or f.

Every organism is at first sexless, though containing potentially a sex-producing capacity. See Bonellia; Hermaphrodite; Homozygote; Sacculina.

**S.-chromosomes.** Chromo-

somes which determine sex of future organism. One of the chromosomes which, in the heterozygous sex, is mated with a dissimilar homologue.

In humans the sex-chromosomes of the f. gamete (ovum) are bisexual and therefore do not figure in determining the offspring's sex, for each ovum can develop into a m. or a f. The sex-chromosomes of m. gamete (spermatozoon) are of two types, a small, m.-producing, and a large, f.-producing. Out of an average 5,000,000 m. gametes discharged at coitus, 250,000 contain small m.-producing chromosomes, 250,000 contain large chromosomes that are f.-producing. In the m. each cell has 2 dissimilar sex-chromosomes, an *x* and a *y*. In the f. the paired members are *x* and *x*—there is no *y*. Such is the state in all somatic cells and in *unripe* gametes. In ripe gametes there is only one *x* chromosome to each ovum and either one *x* or one *y* to each spermatozoon. *Syn.* idio-chromosome; monosome; heteropic c. or hetero-chromosome; *x* or *y* chromosome.

**S.-differentiation.** Probably arose through necessity of storing food for nourishment of next generation. Thus arose a large, sedentary, well-nourished megagamete or ovum, and a small, active, poorly-nourished microgamete or spermatozoon. **S.-glands.** M. Testis of an., anther of pl.; f. ovary of an. and pl.

**Sextant.** Instrument for measuring angular distances for determination of lat. and long.

**Sexual dimorphism.** In conjugation of very primitive cells, the pairing partners have neither maleness nor femaleness and are much alike. In slightly higher forms the conjugating individuals are dissimilar, as in flagellate infusoria; this is the beginning of s.d.; in the highest an. the dissimilarity,

and therefore the s.d., is very marked. **S. selection.** A variety of *natural selection* with the difference that whereas the latter presupposes a passive f., s.s. demands definite choice on her part of the most desirable m.—the strongest, or largest, or brightest coloured, or finest singer, etc.—to father her progeny. The f. who succeed in gaining the finest and most vigorous m. rear more offspring than those who have to be content with second-rate m. **S. union.** Conjugation; syn-gamy; copulation; coitus. **S. zoöite.** Medusoid.

**Shale.** Consolidated and laminated clay or silt.

**Shear.** Stress (*q.v.*) in a body due to a force acting parallel with its section.

**Shell.** (1) Hard, rigid, outer, protective covering of an an. or of a seed, etc.; it may be calcareous, siliceous, chitinous, bony, horny, or fibrous. (2) An explosive-filled projectile. **Shell-fish.** A shelled mollusc. **Shellac.** Purified lac resin.

**Ship-worm.** *Teredo*, and other wood-boring molluscs.

**Shoot.** (1) Part of pl. which first rises into air out of the ground. (2) New growth from a bud.

**Short-circuit.** The taking by a current of a less resistant (usually shorter) route through accidental contact of a third conductor with the two correct ones.

**Shoulder-girdle.** Scapula and supra-scapula (fused in man), coracoid and pre-coracoid (latter replaced by clavicle in mammals). In ornitho-rhynchus and birds an inter-clavicle (merry-thought) exists

which is represented in man by a ligament. *Syn.* pectoral arch.

**Shrapnel.** Bullet-filled explosive shell (*q.v.*).

**Shrub.** Low, many-stemmed, woody pl.

**Shunt.** A conductor which can be joined with two points in a circuit and through which a part of an electric current can be deviated.

**Sialoid.** *Per. saliva.*

**Side-chain.** A branch "chain" of atoms attached to the main group of atoms in a mol.

**Sidereal.** *Per.* fixed stars and their apparent motion. *See* Day; Year. **Siderite.** Iron meteorite.

**Side-slip, aer.** Sliding of air-plane downwards and sideways in the line of its tilted lateral axis.

**Sieve-plates.** Perforated parts of the walls of tubes that make up s.-tissue. **S.-tissue.** Elongated cells and their perforated walls (s.-plates) which, with the *companion cells*, make up the s.-tubes. **S.-tubes.** Part of phloem. Long, slender structures in bast consisting of elongated, end-to-end cells and their walls which function as channels of conduction. *Syn.* s.-vessels. **S.-vessels.** S.-tubes (*q.v.*).

**Sigillate, bot.** Having little adornments or seal-like markings.

**Sigma.**  $\Sigma$ . Greek S. Symbol indicating summation; or, as a numeral, 200; as a fraction, a mille-second or 1/1000 sec.

**Silage.** Compressed, acid-fermented fodder.

**Silica.**  $\text{SiO}_2$ . Silicon di-

oxide. *Ex.* quartz; sand: opal. Silicate. Salt or ester of silicic acid. Siliceous. *Per.* silica. Silicle. Silique. Silicole. Sand-inhabiting pl. Silicon, *ch. el.* Si. Metalloid. *At. no.* 14; *at. wt.* 28.06. Silicle, -que. A many-seeded pod (*g.v.*) silicle. *See* Fruit.

Silo. Apparatus for converting fodder into silage.

Silt. *See* Sand.

Silurian. Early middle palæozoic following ordovician, preceding devonian.

Silver, *ch. el.* Ag. Metal. *At. no.* 47; *at. wt.* 107.880. S., German. Copper-nickel-zinc alloy.

Simian fissure. Groove in occipital lobe of brain, well-developed in lower apes among which it was at one time thought to be solely present. It is, however, slightly developed in higher apes and in man, though occasionally absent in members of highly-civilized human races. *Sulcus lunatus*. Simiidae. Anthropoid apes, a fam. of catarrhines of O. primates. They are arboreal, without cheek-pouches or tail, and, excepting gibbon, no ischial tuberosities; they walk semi-erect, placing backs of their fingers on the ground; they have a vermiform appendix, and a placenta which differs from that of monkeys but exactly resembles that of man. *Ex.* gorilla; chimpanzee; orang; and gibbon.

Simoom. Hot, dry, dust-laden wind of central Asia.

Sine. (1) Ratio of length of perpendicular drawn from one end of arc of circle upon the d. of the circle that passes

through other end of arc, to the length of the radius of the circle reckoned in the pos. sense when the perpendicular is upward, in the neg. sense when downward. (2) One of six ratios of an angle ( $a$ ) which can be formed from the sides of a right-angled triangle; they are:—

*Sine* = side opp.  $a$  div. by hypotenuse.

*Cosine* = side adjacent to  $a$  div. by hypotenuse.

*Tangent* = side opp.  $a$  div. by side adjacent to  $a$ .

*Cosecant* = inverse of sine.

*Secant* = inverse of cosine.

*Cotangent* = inverse of tangent.

Sinistral. *Per.* left. Having whorls turning clockwise—i.e., from left to right. *Cf.* Dextral. Sinistro-gyrate, -rse, -tropie, -tropism. Winding up a stem clockwise—from right to left. *Opp.* dextrotropic; dextorse. *Ex.* hop and honeysuckle are sinistorse, climbing clockwise; convolvulus and scarlet-runner are dextorse, climbing anti-clockwise.

Sinu-ate, -ous. Winding; tortuous; wavy; indented; gyrose. Sinus. Cavity, channel, dilatation, groove, or tunnel in the tissues. Exit from an abscess-cavity. *Bot.* Depression between two adjacent lobes. Sinusoid. (1) Curve, the ordinates of which are proportional to sines of abscissas. (2) Blood-space.

Siphon. (1) A U-shaped tube by which a liquid can be forced by atmospheric p. over an elevation to a lower level. (2) Accessory gut in worms. A gonostyle (*g.v.*). (3) Swimming-funnel of cephalopod.

(4) **Inhalent** and **exhalent** tubes formed by coalesced mantle-lobes in bivalves. (5) Tube connecting compartments in Nautilus. (6) Branchial aperture of ascidians. (7) Sucking proboscis. (8) Honey-tube of aphids. (9) Hydranth or trophozooid. *Syn.* siphuncle. Siphonet. Siphonogam-ic, -ous, -y. Pollen-tube fertilization. Siphonophora. O. of hydrozoa. Siphonosome. Nutritive and reproductive zooids of siphonophora. Siphonostele. Hollow, vascular, pith-containing cylinder of a stem (ex. fern). Siphonostomatous. Having a tubular sucking mouth, or a protrusible siphon. Siphonozooid. Zooid (devoid of tentacles and gonads) which regulates water-supply of Alcyonaria colony. *Cf.* Autozooid. Siphuncle. Siphon.

**Sipunculoidea.** Marine worms. *Gephyrea.*

**Siredon.** Axolotl. **Sirenia.** O. of marine herbivorous mammals. *Ex.* manatee.

**Sirocco.** Southerly, moist, dust-laden wind from Libyan desert.

**Sitotropism.** Response to food stimulus.

**Size.** Magnitude; extent of dimensions.

*Ex.* (approximations) radius of electron,  $10^{-13}$  cm.; w.-l. of gamma radiation,  $7 \times 10^{-3}$  cm.; d. of mol. of hydrogen,  $2.17 \times 10^{-8}$  cm.; ditto, oxygen,  $2.99 \times 10^{-4}$  cm.; w.-l. of X-ray,  $10^{-3}$  cm.; ditto, red,  $76 \times 10^{-4}$  cm.; d. influenza bacillus,  $1/29,000$  cm.; d. red blood-corpuscle  $1/1280$  cm.; l. of relapsing-fever spirillum,  $1/250$  cm.; height of av. man  $150$  cm.; ditto Everest  $9 \times 10^4$  cm.; earth-sun distance,  $10^{13}$  cm.; nearest fixed star,  $10^{13}$  cm.; d. of our (milky-

way) universe,  $10^{22}$  cm.; d. of explored cosmos  $2 \times 10^{24}$  cm. *See* Volume; wave.

**Skeletogenous.** *App.* skeleton-producing cells. **Skeleton.** Rigid, protecting, supporting part of an.; if outside, as in beetle, it is an *exoskeleton*; if inside, as in vert., it is an *endoskeleton*. The materials, in the former, are carbonate of lime, silica, keratin, chitin, conchiolin, collagen, spongin, tunicin, etc.; in the latter, cartilage and bone. There are in the skeleton of man some 206 bones varying in size from the bone of the thigh to an ossicle of the ear.

**Skia-gram, -graph.** Shadow-picture—especially that made by X-ray.

**Skin.** Integument. Tissues covering an organism. The covering of the early human embryo is fish-like—a single, translucent layer of *epithelium*, the *ectoderm* or *epiblast*. About the third month this aquatic type of skin differentiates into the terrestrial type composed of an outer horny layer, the *periderm* or *epitrichium* (*epidermis* or *cuticle*) from which, subsequently, hairs grow; and an inner, softer layer, the *corium*, *dermis*, or *derma*.

**Skull.** Bony (or cartilaginous) framework enclosing and protecting the brain. The human skull consists of 29 bones and 32 teeth.

**Slag.** After-product of smelting, consisting of silicates of calcium, magnesium, and aluminium.

**Slate.** Metamorphosed clay and shale lying in parallel cleavage planes.

**Sleet.** Partly-frozen rain.

**Slide-rule.** Ruler and sliding attachment (both graduated) for mathematical calculations.

**Slime-fungus, -mould.** Myxomycetes.

**Slipper-animalcule.** Paramecium.

**Smell.** Impression produced in olfactory centre of brain by nerve-impulses set up by impact of gaseous mol. and minute solid particles on the peripheral end of the olfactory nerve in the nose. A particle less than  $1/150,000,000$  grain can arouse smell. **S.-brain.** Archipallium.

**Rhinen-cephalon.** **S.-gland.** Osmeterium (*q.v.*). **S.-organ.** Osphradium (*q.v.*). Parabanchia. **Smelt.** *n.* Fish. *v.* To fuse and refine.

**Smoke.** Minute carbon particles set free during imperfect combustion of organic matter.

**Snow.** Multishaped crystals (belonging to hexagonal system) formed by slow freezing of water-vapour. *Cf.* Hail; Ice. **S.-line.** 0 ft. at poles; 9000 ft. at lat. 45; 16,000 ft. at equator. **S., red.** Snow coloured by hæmatochrome (*q.v.*), *chlamydomonas*, or *sphaerella nivalis*.

**Soap.** Combination of a salt and a fatty acid; *hard* soap is sodium stearate ( $C_{18}H_{35}O_2Na$ ); *soft* soap is potassium oleate.

**Soboles.** Sucker; stolon; shoot.

**Soda.** *Per.* oxides or carbonates of sodium. **S.-water.** Water charged with carbon dioxide; it contains *no* soda.

**Sodium, ch. el.** Na. Metal. *At. no.* 11; *at. wt.* 22.997.

**Sol.** *A* suspension; *a* pseudo-solution—*e.g.*, *a* colloid and water. *Cf.* Gel.

**Solar constant.** Quantity of sun's radiant heat received on outer layers of earth's atmosphere. It = 1.94 cal. per sq. cm. per min. **S. system.** The sun with, revolving around it, 9 planets, 26 satellites, some 1200 asteroids, countless meteors, and many comets.

**Solenocyte.** Club-shaped, tubular, flagellated cell of excretory system of worms, amphioxus, etc.

**Solenoid.** Cylindrical helix of wire which acts as a magnet when carrying a current.

**Solid.** State of aggregation of matter in which the particles as a whole are relatively of stable shape and vol. *Cf.* Gas; Liquid.

**Solidifying point.** Temp. at which liquid becomes solid. *Cf.* Melting point. *See* Fusion. **Solidungulate, Soliped.** Whole or solid-hoofed.

**Solstice.** Times at which sun attains greatest distance N. (June 21) and S. (Dec. 22) of equator.

**Solute.** Dissolved substance. *Cf.* Solvent. **Solution.** Condition of a substance (solute) being dissolved in a liquid (solvent).

Gases can be in solution in liquids or one gas can be in solution in another gas; a solid can also be in solution in another solid. *Cf.* Suspension. *See* Concentration; Sol.

**S. pressure, S. tension.** The p. or tension forcing particles of a dissolving substance into solution. When solution p. = osmotic p., equilibrium is established. It is the solution p. of metallic salts in a voltaic cell that causes electric current (*q.v.*).

**Solvent.** Substance which

effects solution of another substance. *Cf.* Solute.

**Soma.** The body of an an. or pl. exclusive of germ-cells. **Somatic cell.** A body-cell as *cf.* c. a germ-cell. **Somatoblast.** Cell which differentiates into body-cell. **Somatogenetic, -ous.** Originating in, or producing, body-cells. **Somatome.** Somite. **Somatoplasm.** (1) Protoplasm of body-cell. *Cf.* Germ-plasm. (2) Cytoplasm. **Somatopleure.** Body-wall; it is the outer of two layers into which mesoblast splits, the inner being *splanchnopleure* (*q.v.*) and the intervening space the *coelom* (*q.v.*). *See* Mesoderm. **Somatotropism.** Selective attraction (*e.g.*, of microbes or of phagocytes) to body-cells. **Somite.** One of the divs. of a metamerically-segmented organism. Body-segment; mesomere; metamere; somatome.

**Sonic depth finder.** Apparatus for determining depth based on time-interval between sound-emission just below surface and reception of echo from ocean bottom.

**Soral.** *Per.* sorus. **Soredium.** Group of fungus and alga cells on thallus of lichen. **Sori.** Plural of sorus (*q.v.*). **Sorosis.** Composite, succulent fruit (*q.v.*) consisting of fused fleshy axis and flowers. *Ex.* pineapple. **Sorus.** Receptacle on under-side of fern frond covered by *indusium* and containing *sporangia*. Plural, sori.

**Sound.** (1) Sensation aroused by vibrations at cert. rates. (2) Vibrations arousing such sensation. **S.-organs.** Any mechanism in living an. for emitting sound-waves;

**larynx, syrinx, limbs, abdominal appendages, etc.** **S.-waves.** Periodic compressions and decompressions of medium transmitting the sound irrespective of any hearing.

The particles of the medium oscillate in the direction of the wave-advance—*i.e.*, the waves are *longitudinal*. (Light and water waves are *transverse*—*i.e.*, the waves are at right angles to the direction of travel.) The speed of s.-w. is greater with increase of density and elasticity, as following examples show: rubber, 100 (f.s.); ether vapour, 588; air at 0° C., 760 mm. p., 1093; water vapour, 1315; liquid chloroform, 3225; lead, 4653; fresh water, 4708; sea-water, 4761; gold, 7021; copper, 12,140; oak, 14,435; iron, 16,820; glass, 19,000 f.s. *See* Audibility; Bel; Phon.

**S. range.** This varies according to individual and species. The human range is about 30.0 to 40,000 vibrations per sec. The middle C of piano is 256. *See* Audibility; Phon.

**Space.** (1) The void. (2) That which receives a body. (3) The empty framework within which substantial objects are arranged. ["Objects cannot exist without s." (Newton). "S. cannot exist without objects." (Einstein) (!)]. (4) Three-dimensional continuum. (5) An external entity. (Jeans). (6) That through which radiations (and particles) travel. (7) Boundless, all-directional extension and indefinite divisibility. (8) That which (without ether) transmits electromagnetic and gravitational forces.

Whereas an "event" is conceived by some as occurring at a point in three-dimensional s., and at an instant of dimensionless time, it is conceived by others (relativists) as occurring at a point in a four-dimensional s.-time continuum. Einstein declares that



matter "warps" s., so that a ray of light travelling for  $5 \times 10^{11}$  years arrives back at its starting point.

**S.**, density of. The mean density of, or *average* amount of matter in, s. is, for the whole known universe, such as to make it  $1.5 \times 10^{-31}$  times the density of water (Hubble). **S.-time.** Four-dimensional order within which a physical phenomenon is determinable by specification of one temporal and three spatial coordinates. **S.-time-continuum.** Four-dimensional space with three Euclidian axes and a fourth time-variation axis.

**Spadic-eous, -ose.** Having flowers on a spadix. **Spadix.** (1) Racemose inflorescence with elongated axis, sessile flowers, and an enveloping spathe. *Ex. arum.* (2) Succulent spike bearing staminate and pistillate flowers. (3) Modified tentacles and sheaths of cephalopods (nautilus).

**Spasm.** (1) Paroxysmal feeling or action. (2) Involuntary muscle contraction—*tonic*, when contraction is uniform and steady, *clonic*, when there are several contractions with intervening relaxations. **Spastic.** *Per.* spasm. *Hyper-tonic.*

**Spathe.** Membranous leaf enveloping spadix; bract enclosing flowers. **Spathella.** Small spathe. **Spatulate.** Spoon-shaped.

**Spawn.** (1) Collection of gelatinous eggs of frogs, fishes, etc. (2) Mycelium.

**Spay.** *v.* To remove the ovaries. *See* Castrate. *n.* Three-year-old deer.

**Specialization.** (1) Development of a particular organ with

a particular function. (2) Enhanced efficiency in one function at expense of other functions. Differentiation.

**Species.** The smallest group of organisms possessing distinctive and invariable characters. A relatively (not absolutely) permanent group of organisms which closely resemble one another owing to descent from common ancestors, and at the same time differ from all other s.

A s. is *not* fixed, for one form gives rise—after longer or shorter intervals—to another. The sp. character, however, constituting the s., exhibits constancy from one generation to another. The distinction between two s. is always greater than the mean difference between members of a family. Members of a s. are infertile but (as a rule) are not fertile with members of other s. A s. is made up of *varieties*, a *genus* of s., and a *family* of genera. The no. of s. of an. varies from one to thousands. Man, *e.g.*, has but one species—*Homo sapiens*. On the other hand, felines comprise 40 s.; the hemichordata, 50; rotifers, 850; urochordata, 1400; thread-worms, 1600; amphibians, 1800; sponges, 2500; annelid worms, 4000; flatworms, 4500; arachnids, 5000; reptiles, 5000; mammals, 7000; coelenterates, 7000; crustaceans, 8000; protozoa, 10,000; echinoderms, 10,000; fishes, 12,000; birds, 20,000; molluscs and molluscoids, 62,700; coleoptera, 250,000; insects, 500,000.

**Specific.** *Per.* species, or to a peculiar property or influence. Designating some physical constant, ratio, or quantity. A reliable remedy. **S. gravity.** Ratio between wt. of a given vol. of a substance and the wt. of the same vol. of pure water at 3-945° C. **Sp. gr.** is the reciprocal of sp. vol. (*q.v.*). **Syn. density** (*q.v.*).

**Sp. gr.** is a *relative*, not an absolute, quantity. Thus, when it is said that

the sp. gr. of cork is 0.2, of ice is 0.9, aluminium 2.6, iron 7.7, silver 10.4, and of platinum 22, this means that, vol. for vol., each of these substances is this no. of times respectively the wt. of water. The sp. gr. of a gas is the ratio of the mass of a vol. of the gas to that of same vol. of air under same temp. and p. Sp. gr. of air at 0° C. and 760 mm. p. is 1.0; of hydrogen, is 0.0693; of nitrogen, 0.96737, of chlorine, 3.44.

**S. heat.** The no. of units of heat required to raise unit mass of a substance through 1° C.; or, the quantity of gramme-calories required to raise the temp. of 1 gramme of substance through 1° C.

Thus, the sp. h. of lead is 0.0314—i.e., the quantity of h. necessary to raise the temp. of a given wt. of lead through 1° C. would raise the temp. of same wt. of water through 0.0314° C., or, in other words, 0.0314 calorie is required to heat 1 gramme of lead through 1° C.

Sp. h. varies with temp. Water at 0° C., or at 51° C., is taken as unit; at 30°, 80°, and 100° C. the sp. h. of water is, respectively, 0.98, 1.01 and 1.03. The sp. h. of ice at 0° C. is 0.504. The sp. h. of a gas at constant p. is — sp. h. at constant vol. *plus* work effected in former case by the expanding gas. If sp. h. be multiplied by *at. wt.* the result is *at. heat*. Summation of *at. heats* gives the *molecular heat* of a compound; thus, *at. heat* of K is 6.5, of Br 6.7; the *molecular heat* of KBr is 13.2.

**S. inductive capacity.** If above a gold-leaf electroscope an electrified body which diverges the leaves be held, and if then another body be interposed between the electrified one and the electroscope, there will ensue a greater, or lesser, or no change in divergence of leaves according to kind of body interposed. The ratio of the inductive power of air to the interposed body is the *s.i.c.* Taking air as 1.0, shellac is 2.5, amber 2.8, sulphur 4.0, glass 8.0, water 80. **S. volume.** The

vol. occupied by unit wt. of a substance. It is the reciprocal of sp. gr. Referred to water at max. sp. gr. and temp. 3.945° C. as standard, it is the no. of c.c. occupied by 1 gramme of the substance.

**Spectral type.** System of star classification based on relative intensity variations of cert. lines in the spectra of the stars. **Spectrometer.** Instrument for determining indices of refraction; also for quantitatively analysing radiation into its component frequencies. **Spectroscope.** Optical instrument for determining composition and relative movements of luminous bodies (stars) by means of their spectra; also for the qualitative investigation of the component frequencies of their radiations. **Spectrum.** A broad beam (not necessarily visible) of radiation in which the several component radiations are arranged side by side in the order of freq. and w.-l.

Thus, the visible s. (violet-indigo-blue-green-yellow-orange-red rays) lies approximately between 3600 A.U. (violet) and 7600 A.U. (red). The ultra-violet, X-ray, and  $\gamma$ -ray s. is below 3600 A.U.; the dark heat and Hertzian s. is above 7600 A.U. See Angström Unit. A *continuous* s. has no gaps, all w.-l. being represented. A band s. shows groups of lines or bands, and is characteristic of emission by mols. A *line* or *absorption* s. shows dark lines due to absorption by the medium traversed of cert. rays. An *emission* s. is that of the radiation emitted at source. See Coloration; Light; Radiation; Lyman.

**Speed.** Rate of movement.

Speed is a *scalar* quantity and represents the *magnitude* of a *velocity*. Vel. implies direction—thus a s. of 10 ft. per sec. means that rate of motion in any direction, but a vel. 10 ft. per sec. implies a motion in a northerly, or southerly, or other direction. A point can move with

uniform s. in a circle, but not with uniform vel. in a circle. Cf. Velocity.

**Spelæan.** Dwelling in caves.

**Spelter.** Zinc in slabs.

**Spemann's organizer.** Ch. substance produced in gastrula of embryo which induces primitive cells to specialize congruous with their particular normal site. It will induce formation—e.g., of nerve tissue—if injected into a part of an embryo where nerve tissue is not normally present.

**Sperm.** Seed. Semen. **Spermatozoa.** M. fecundating els. **S. cell.** A gamete (q.v.). **Spermato-cyte,** -zoon. **S. centrosome.** (1) Terminal swelling of axial filament of spermatozoon immediately behind head. (2) Small body at apex of head of spermatozoon.

**Syn. spermocentre. S.-mother-cell.** Ancestral cell of spermatozoon. **Spermatoocyte.** Spermato-blast, -gemma, -gonium, -mere, -sphere, -spore. **Spermaceti.** Oily extracts (palmitates) from the cachalot or s. whale. **Spermacyte.** Spermatoocyte. **Spermary.** Any sperm-containing receptacle. **Sperm-gland;** pollen-tube; testis; spermatozyst; seminal sac. **Spermangium.** Multicellular algal antheridium. Cf. Spermatozyst. **Spermateleosis.** Spermatogenesis.

**Spermatheca.** Sac in f. organisms that stores spermatozoa from the m. until required for fertilization of ova. **Bursa copulatrix** (q.v.). **Spermotheca.** **Spermatid.** Stage in sperm development succeeding spermatoocyte, preceding spermatozoon. **Syn. spermatoblast. Spermatiophore.** Spermatiaproducing sporophore (q.v.)

**Spermatium.** Non-motile m. gamete in cert. algæ, fungi, rusts, lichens. **Spermatozoon.** Pollinoid-producing element. See Paraphyses. **Spermato-blast.** Sperm-producing cell. **Spermatid.** Sertoli cell (q.v.). **Sperm-mother-cell.** **Spermatozyst.** Seminal sac. **Unicellular antheridium.** Cf. **Spermatangium.** **Spermato-cyte.** Cell from which first spermatid, and thence spermatozoon, arises. Cell of spermatogonium (q.v.). **Spermacyte.** **Auxocyte.** Sperm-mother-cell (q.v.). See Cyte; Gonia. **Spermatogemma.** Sperm-mother-cell. **Spermatogenesis, -y.** Origin of spermatozoa. **Spermateleosis.** **Spermatozone, -gonium.** Primitive m. germ-cell from which spermatoocyte (q.v.) arises and from this, a spermatozoon. **Sperm-mother-cell.** **Spermatomere.** Sperm-mother-cell. **Spermatomere.** Chromatin particle in head of spermatozoon. **Spermato-phore.** Any sperm-carrying organ. **Spermophore.** Hectocotylus. Sperm capsule or "packet." **Spermatoplasm.** Protoplasm of m. gamete. **Spermatoplast.** Spermato-zoid, -zoon. **Spermatosome.** Spermatozoon, especially the middle part. The "body," apart from chromosomes, of m. gamete. **Spermatosphere.** Sperm-mother-cell. **Spermatospore.** Sperm-mother-cell. **Spermatotheca.** **Spermatheca.** **Spermatozeugma.** In cert. insects the union by conjugation of two or more spermatozoa. **Spermatozoa.** Sing. spermatozoon (q.v.). **Spermatozoid.** The m. gamete or spermatozoon of pl.; it arises from the

**antheridium**, unites with oophore to form oospore. Generative cell of *pinus*. **Antherozoid**. See Alternation. **Spermatozoon**. Plural spermatozoa. The m. gamete or fertilizing organism. Micro-, spermogamete.

In mammals it is the direct descendant of spermatid, indirect descendant of spermatocyte and spermatogonium. It consists of a "head," the nucleus, or m. pro-nucleus containing centrosomes,  $1/4000$  in. long; a middle part (spermatosome) containing mitochondria,  $1/4000$  in., and a locomotory tail or flagellum,  $1/670$  in.; total length c.  $1/500$  in. *Syn.* sperm cell; spermato-plast, -some, -zoid; spermium; spermogamete. See **Spermioalypthrothea**. Cf. Zoospore.

**Spermin**.  $C_5H_{14}N_2$ . A leucomaine (S.L.) of spermiatic and other an. fluids. **Spermioalypthrothea**. Cap-like structure over fore part of head of spermatozoon. **Spermocarp**. Fertilized oogonium of algae. **Spermomorph**. Outer covering of seed. **Spermogamete**. Microgamete. **Spermogone**, -gonium. A cell that, by fission, produces a brood of sperms (*ex. volvox*). **Antheridium**. Capsule in fungi and lichens containing spermatia. A flask-shaped body which produces spermatium [with its pollinoid (m. gametes)] and paraphyses (*g.v.*) (sterile hyphae). Cf. **Sporocarp**. **Spermophyte**. A sexual, sperm-producing generation. See Alternation. Cf. **Oophyte**. **Spermosporangium**. Sperm-producing sporangium. Cf. **Ovosporangia**. **Spermotheca**. **Spermatheca**.

**Sphacelate**. Gangrenous; withered; decayed. **Sphacelia**. Ergot conidia.

**Sphaeraphides**. Globular groups of crystals in pl.-cells.

**Sphaerelia**. **Hæmatococcus**. **Sphaerenchyma**. Tissue composed of spherical cells. **Sphaeridia**. Rounded glassy spheres on echinoderms; ? balancing-organs. **Sphagnicolous**. Inhabiting bog-moss. **Sphagnum**. Bog-moss.

**Sphenodon**. **Hatteria**. Tuatara. Nocturnal, rock-inhabiting, lizard-like creature of New Zealand; the only living representative of the *Cl.* Rhynchocephalia. It is about  $1\frac{1}{2}$  ft. long, has biconcave vertebrae, abdominal ribs, and a third (pineal or parietal) eye with traces of lens, optic nerve, and retina.

**Sphenoid**.  $\alpha$ . Wedge-shaped.  $\pi$ . Bone in skull.

**Sphere**. A body, or space-vol., any point in surface of which is equidistant from centre, and this is the mid-point of a straight line drawn perpendicular to a tangent at the surface to the opp. surface. *S.*, surface of. Four times area of great circle;  $4\pi r^2$ ;  $\pi d^2$ ;  $3.14159 \times d^2$ ;  $12.56636 \times r^2$ . *S.*, volume of.  $\frac{4}{3}$  surface area  $\times d$ ;  $0.52359 \times d^3$ ;  $\frac{4}{3}\pi r^3$ ;  $4.188786 r^3$ ;  $\frac{1}{6}\pi d^3$ . **Spheroid**. Resembling a sphere. **Spheroidal state**. *App.* state of a liquid—*e.g.*, water which, when thrown on to very hot metal, becomes spheroid in shape and remains at a temp. well below the *b.p.* of water because it is resting on a cushion of steam without any contact with the metal. **Spheroplasts**. Chondriosomes; mitochondria; bioblasts (*g.v.*). **Sphincter**. A ring-like muscle closing an orifice. *Ex. s. ani.*

**Sphygmie**. *Per.* pulse. **Sphygmogram**. Pulse-tracing

as registered by a sphygmograph. **Sphygmograph.** Instrument for recording arterial pressure-waves. **Sphygmoid.** Pulse-like; pulsating.

**Spic-al, -ate, -ose.** (1) Beset with spines, prickles, etc. (2) *Per.* inflorescence arranged in spikes. **Spicule.** Hard, pointed structure; siliceous or calcareous el. (sponges); spikelet.

**Spigot.** See *Fusula*.

**Spike.** Racemose inflorescence with axial sessile flowers. **Strobile.**

**Spinal canal.** Cf. *Neurenteric canal*. Canal lodging *spinal cord* (*q.v.*) and extending length of the backbone. **S. column.** Spine or *backbone* consisting (in man) of 33 or 34 jointed segments, 7 cervical, 12 dorsal, 5 lumbar, 5 sacral, and 4 or 5 coccygeal vertebrae, and their discs which (as far as the lumbar vertebra) protect and lodge the cord. **S. cord.** *Medulla spinalis*; neural tube. A long strand of nerve tissue within the spinal canal (*q.v.*) which extends downwards from the brain throwing out nerves to supply limbs and trunk. It is composed of grey matter (*q.v.*) internally and white matter externally.

**Spindle.** (1) Protoplasmic, achromatic arrangement during karyokinesis (*q.v.*). (2) Elongated peduncle bearing sessile flowers. **Rachis.**

**Spine.** (1) Spinal column (*q.v.*). (2) A ridge or point of bone or woody tissue; fin-ray. **Spinescence.** Gerontic (*q.v.*) production of superfluous skeletal material.

**Spinneret.** Organ, consisting of perforated movable turrets or mammillae (*q.v.*), for pro-

ducing silk threads from liquid silk secreted by silk-glands. See *Fusula*.

**Spiracle.** (1) Breathing aperture in fishes for intake of aerated water to gills; it is probably a vestigial first gill cleft. (2) Exhalant aperture of larval amphibian. (3) Nasal aperture of eetaceans. (4) Opening in lung-book of spiders. (5) Breathing hole of insect. **Stigma.** See *Amphipneust*.

**Spiral.** Path (generally in plane) of a point moving round an axis while continuously receding from, or approaching, it, e.g., a watch-spring, a spiral stair-case. Sometimes *syn. c.* *Helix* (S.L.). See *Helicoid*; *Litrus* (S.L.); *Scorpioid*. **S. genetic.** Line formed by joining insertion points of successive leaves in spirally phyllotactic (*q.v.*) pl. See *Dextral*; *Sinistral*. **S. valve.** Screw-shaped infolding of intestinal wall in fishes, probably to increase absorbent area. **Spiranthy.** Displacement of flower parts through twisting. **Spiræma.** Thread-shaped formation of linin and chromatin in dividing nucleus. **Spiricle.** Coiled thread in seed-coat. **Spirillum.** Twisted, thread-like micro-organism. **Antheridium.** **Spirit.** (1) Mind. (2) Alcoholic solution. (3) Methyl alcohol. **Spirochæte.** Spiral-shaped micro-organism. *Ex. treponema*; trypanosome. **Siprogrya.** F.w. alga; pond scum. **Spirometer.** Instrument for measuring lung capacity. **Spiro-nema.** Spiral thread in infusorian stalk. **Splanchnic.** *Per. viscera.* **Splanchnocoel.** Cavity between splanchno- and somato-pleure.

**Splanchnopleure.** Gut-wall or inner wall of coelom (*q.v.*). See Embryogenic pole; Mesoblast.

**Spleen.** The largest ductless gland; a pulpy, haemolymphatic structure containing blood-spaces in lieu of lymph-spaces.

One of its functions is that of a lymph-gland, since, if removed, all other lymph glands enlarge; other functions are the formation and destruction of red blood-cells.

**Spondyl.** Vertebra.

**Sponges.** Porifera. Aquatic invertebrates with horny (spongin), calcareous, or siliceous skeletons containing cells arranged as an intricate canal-system.

S. start life as free-swimming larvae which soon fix themselves and develop two layers, ecto- and endoderm, and become mature sponges. They contain no true mesoderm for they represent a stage of life when this tissue had not yet evolved. There are 2,500 species (*q.v.*) of sponges.

**Spongin.** Chitinous skeletal substance of sponges. **Spongoblast.** (1) Spongin-producing cell. (2) Precursor of neuroglia cell. (3) Amacrine cell. **S.-plasm.** Reticular protoplasm as *cf.* c. Hyaloplasm (*q.v.*). *Syn.* cytoreticulum; polioplasm. **Spongophare.** Flagellated spaces of sponge as *cf.* c. the lower, chamberless part or hypophare.

**Spontaneous generation.** Abiogenesis. **Spontaneity.** Automatism; action without apparent cause. *App.* tendency of organisms to vary without apparent relationship to environment; also to muscle contraction without known stimulus, or to electron jumps without known cause.

Strictly speaking, however, there is no such thing as a spontaneous action, since every action has a cause in some stimulus or excitation, etc. There can be no effect without antecedent action. See Determinism.

**Sporadic.** Scattered; occurring occasionally; isolated.

**Sporangiole.** Small sporangium. **Sporangiophore.** Stalk or hypha bearing sporangia. **Sporangiospore.** Spore from sporangium. **Sporangium.** An organ that produces "spores," whether m. sperms (spermo-sporangium), f. ova (ovosporangium), or both. Capsule or sac in which spores are produced. Rounded end of aerial hypha. Swelling at tip of sporangiophore. Mature sporophyte. Spore-case. Rounded body borne on conidiophore containing conidiospores. Spore mother-cell. Spore capsule. Mega-, micro-sporangium. Theca. Ootheca. Sporophydium. See Columella; Gametangium; Gonidangium. **Spore.** Cell produced by cert. plants and protozoa specialized for reproduction but not for fertilization. It is a product of meiosis (*q.v.*) and gives rise to gametes (*q.v.*). Minute cell capable of developing independently into a new individual without sexual process.

In ferns the s. arises from sporangium and produces gametophyte. In liverworts and mosses it is produced by sporophyte and gives rise to protonema (*q.v.*). *Syn.* acidio-, aplano-arche, asco-spore; brood-cell; conidium; macroconidium; carpo-, conidio-, macro-, mega-, meri-, micro-spore; macro-, micro-, zoo-spore; oospore; hypno-, proto-, pycnidio-, teleuto-, uredo-spore; resting-, winter-, swarm-spore; sporidium; zoo-, zygo-spore. See Alternation.

**S. mother-cell.** (1) Parent cell of s. (2) One of sixteen cells

produced by div. of archespore. **Sporetia**. Idiochromidia (*q.v.*). **Sporidi-ole, -olum**. Sporidium. Protobasidium. **Sporidium**. Gonidium of gonidiophore. An ascospore. Sporidiole. Spore abjected from promycelium. **Sporiparity**. Sporulation. *See* Reproduction. **Sporoblast**. Mother cell of spores and sporozoites. Archespore. **Sporocarp, -ium**. Ascocarp of fungi. **Æcidocarp** of basidiomycetes which generates æcidiospores. Cystocarp. **Sporogonium**. Structure produced by archicarp (procarp) in red algæ which originates earpospores. *Cf.* Spermatogonium. **Sporocyst**. (1) Spore-containing cyst in protozoa. (2) Encysted embryo stage of trematodes in which *redia* are produced. (3) Asexual spore-producing resting-cell. *See* Alternation. **Sporocystid**. Oocyst of protozoa. **Sporocyte**. Spore mother-cell. Auxocyte. **Sporogenesis, -y**. Reproduction by spores. Spore formation. Amph-, sporo-gony. **Sporogonium**. Stalked, spore-containing capsule on thallus of liverworts and mosses; in the latter it arises from the fertilized oosphere of archegonium and produces asexual spores. Sporophyte. **Sporogony**. Gamogony; sporogenesis (*q.v.*). **Sporokinete**. Motile spore. **Sporont**. Spore-producing encysted cell. Sporulating oospore or zygote. Sporozoite devoid of epimerite. Amphiont. Gametocyte. Gamont. Microgonidium. **Sporophore**. Spore-producing organ. Practically eq. sporophyte (*q.v.*) of ferns or placenta (*q.v.*) of seed-pl. *See* Gameto-

Spermatio-phore. **Sporophyll**. Spore-bearing leaf. Leaf-like structure bearing sporangia. Scale-leaf. **Sporophyte**. Individual (or generation in alternation of generations, *q.v.*) that bears asexual spores. Sporogonium of bryophytes; the conspicuous pl. of pteridophytes. A stem bearing sporophylls; a leaf bearing sporangia.

In *pinus* the sporophyte arises from oospore and produces m. pollen-sac or microsporangium and the f. ovule or megasporangium. In ferns it arises from oospore and produces sporangium. In *ligulate* it arises from oospore and produces mega- and micro-sporangia. In liverworts and mosses it also arises from oospore and produces spores. In *flowering* pl. the whole organism is in reality a sporophyte. *Note*.—The nucleus of sporophyte possesses twice the no. of chromosomes in the nucleus of the gametophyte (*q.v.*); hence a sporophyte is a spore-producing "diploid" (*q.v.*). *Syn.* sporogonium.

**Sporoplasm**. Protoplasm of spore, of sporozoon, or of sporozoite. **Sporosac**. (1) Gonad-containing sac. (2) Sporocyst. (3) *Redia*-sac. (4) Degraded reproductive zooid. **Sporozoa**. Parasitic protozoa, usually non-motile with sexual and asexual phases and reproduction by spores. *Ex.* malaria protozoon. **Sporozoite**. Active spore liberated by rupture of spore-membrane. Incipient sporozoon. Exotospore. Sickie-shaped zoospore. **Sport**. Sudden variation. Mutation (*q.v.*).

**Sporulation**. Reproduction by encystation followed by multiple cell-fission and liberation of cell-spores. *Syn.* endogenous multiplication; brood-formation; sporo-genesis, -gony. *See* Brood-cell.

**Sputum.** Spitlike mixed with mucus from the trachea, bronchi, and bronchioles.

**Squamata.** (1) Snakes and lizards. (2) Div. of edentates. **Squam-ate, -oid, -ose, -ous.** Having, or resembling, scales.

**Squarrosa.** Rough. Rigid. Thickly-crowded.

**Squid.** Ten-armed cephalopod.

**Stagnicolous.** Living in stagnant water.

**Stalactite, Stalagmite.** Conical, icicle-like deposits of crystalline calcium carbonate, respectively depending from (apex downwards) a roof and uprising from (apex upwards) a floor.

**Stamen.** The m. organ of a flower. Pollen-bearing organ. It consists of a filament which arises from the sides of receptacle and bears the anther enclosing the pollen-sacs.

*Morphologically*, a spore-bearing leaf; *physiologically*, a part of androecium (*q.v.*). *Syn.* microsporophyll. See Di-, Mon-, Poly-adelphous; Epl-, Hypo-, Peri-gynous; Epipetale; Staminode.

**Stamin-al, -ate.** Having or *per.* stamen. **Stamin-ode, -oid.** Sterile stamen. Stamen devoid of anther or converted into petaloid organ. *Ex.* penstemon. **Staminody.** Conversion of flower parts into stamens. See Staminode.

**Stann-ic, -ous.** *Per.* tin.

**Stapes.** Stirrup-bone, the innermost of three ossicles of mammalian ear; it probably represents columella of reptiles.

**Staphylococcus.** Bacterium common in pus.

**Star.** Self-luminous celestial body.

**Starch.** Carbohydrate ( $C_6H_{10}O_5$ )<sub>n</sub> formed by *chloroplasts* and stored up in *leucoplasts* of pl., especially in seeds. Amylum.

**Starfish.** Echinoderm, usually five-armed.

**Stasimorphy.** Altered shape due to arrested development.

**Stasis.** Impaired motion—*e.g.*, of blood or of bowels.

**Static.** Stationary action—*e.g.*, pressure, wt. *Per.* forces in equilibrium or to "fixed" electric charge. **Statics.** Study of bodies at rest and of forces in equilibrium. **Statoblast.** Dormant bud in f.-w. invertebrates. Winter-egg. (*q.v.*).

**Hibernaculum** (*q.v.*). **Statocone.** Minute body inside statocyst. **Statocyst.** Sense-organ (containing statocone and statoliths) of equilibrium and orientation. **Otocyst.** Otolith-organ. **Statolith.** Stony body inside statocyst, either loose or borne on statorhab (*q.v.*). Starch grains in cells of root-apex of pl. **Statorhab.** Stalk (in coelenterates) bearing statolith. **Tentaculocyst.** Stauffacher's organ. Vesicle and statolith in aphides—probably an organ of equilibrium.

**Steam.** Invisible vapour into which water is converted when heated or boiled. See Cloud; Fog; Vapour.

**Steapsin.** Pancreatic ferment.

**Stearin.** Solid fat. Glyceryl tristearate.  $C_{57}H_{113}O_6$ . **Stearite.** Soap-stone. **Talc.** **Steatopygia.** Excessive development of fat in buttocks, as in Hottentots.

**Steel.** Iron and carbon alloy; the C being 0.01 to 2.0 p.c.

**Stefan's law.** Total radia-



tion from a black body is proportional to fourth power of its abs. temp.

**Stegocarp-ic, -ous.** Having capsule with operculum and peristome (mosses). **Stegoccephali.** Labyrinthodonts. **Phractamphibia.** Extinct armoured amphibia with cranium roofed by dermal bones. **Stegosaurus.** Huge jurassic dinosaur. It had two rows of bony plates extending along back, and an accessory "brain" in tail (sacral) region larger than head brain.

**Stele.** Thick cylinder of vascular tissue developed from pterome and consisting of pericycle surrounding alternating zones of xylem and phloem in roots and stem.

**Stemma.** Support of antenna. Simple eye. Ocellus. Compound eye facet. Genealogical tree.

**Stenocephaly.** Narrow-headedness. *See* Dolichocephaly.

**Stenohaline.** Adapted to small range of salinity. **Stenonotal.** Having slender thorax. **Stenopetalous, -phyllous, -sepalous.** Having slender petals, leaves, or sepals. **Stenosis.** Narrowing of an orifice. **Stenostomatous.** Narrow-mouthed.

**Stepping.** *See* Transformer.

**Stercor-aceous, -al.** *Per.* faeces. **Stercoricolous.** Living in excrement. **Stercovorous.** Feeding on dung.

**Stereochemistry.** Study of arrangement of atoms and mols. in compounds. **Stereognosis.** Perception of three-dimensional solidity. **Stereography.** Study of form. **Stereoisomerism.** Atomic structure in relation to isomerism. **Stereokinesis.** Thigmotaxis (*q.v.*).

**Stereome, bot.** Supporting tissue. **Stereoplasm.** (1) More solid part of protoplasm. *Cf.* Hygroplasm. (2) Vesicular interseptal substance in corals. **Stereopsis.** Stereoscopic (*q.v.*) vision, a characteristic of primates. **Stereoscop-e, -ic.** Optical apparatus (and *per.* thereto) that combines two images of two nearly similar pictures so as to give an effect of depth and solidity—i.e., arouse an appreciation of three-dimensional space. **Stereospondylous.** *App.* vertebrae whose component els. (neural arches and centra) are fused into one intact amphicelous (*q.v.*) vertebra as in most verte. *Cf.* Rachitomous; Temnospondylous. **Stereotaxy.** Response to contact with solids. **Thigmotaxy.** **Stereotropism.** Response to contact-stimuli. Organisms that place as much of their bodies as possible in contact with solids (worms in burrows, insects, etc., in crevices) exhibit pos. s.; leaves, branches, exhibit neg. s. **Thigmotaxis; haptotropism.**

**Sterile.** (1) Not capable of reproduction. (2) Devoid of living organisms. **Sterilization.** (1) Rendering an an. sterile by ablating gonads (*q.v.*) or tying their ducts, or a pl. by destroying sexual m. or f. organs, the *androcium* or *gynecium*. *See* Castration; Spay. (2) Rendering a solution sterile by heating it above temp. at which an organism can remain alive.

**Sternotribe.** Breast-toucher. *App.* flowers with stamens and pistils so arranged that they rub against the fore-part of entering insects and so en-

compass fertilization of the pl.  
**Sternum.** Breastbone of vertes.  
 Ventral region of insect thorax.  
 Ventral plate of arthropods.

**Sterrula.** Free-swimming ciliated larva preceding planula stage in alcyonaria.

**Stichidium.** Branch holding tetraspore receptacle (red algae).

**Stigma.** A marking on an organism. Eye-spot. Spiracle. Androconium. Coloured wing-spot. Viscid zone on pistil to which pollen sticks. Expanded receptive part of gynoecium at apex of style. Slit in wall of ascidian branchial sac. Opening of insect trachea. Lid-cell of archeogonium. Plural stigmata.

**Stimulant.** Agent which temporarily increases vital activity in a part or whole of an organism. **Stimulus.**

**Stimulus.** (1) Excitant. **Stimulant.** (2) An environmental agent—thermal, luminous, mechanical, chemical, electrical, gravitational, centrifugal—which provokes a response.

Response to stimuli is characteristic of protoplasm but is not absent from inorganic matter—e.g., selenium responds to light, steel to alternating stresses, colloids and osmotic membranes to chemical stimuli. There is no necessary proportion between the energy of a stimulus and that of a reaction, a granule wt. falling on a nerve compels the muscle to lift 10 grammes, a ray of light can be the stimulus that brings about the disruption of a building, a sound-wave (the cry "fire"), can send a crowd into panic flight. See Irritability; Fatigue.

**Sting.** An offensive or defensive organ for injecting poison into another organism. In f. insects the sting is a modified ovipositor and is absent

in males. In cert. fishes (ray) it is a modified fin-ray. **Stinging-cells.** Protective cells furnished with a poison-injecting mechanism. *Ex.* hair-cell of nettle. See Cell; Cnidoblast.

**Stipe.** Stem-like structure. Stalk supporting *pileus* of mushroom. **Stipes.** See Podogynium. **Stipel.** Stipule. **Stipes.** Peduncle of stalked eye. Various stalked appendages in insects, etc. **Eustipes.** **Parastipes.** **Stipe.** **Stipule.** Leaf- or scale-like appendages, or ring of leaflets at base of leaf. **Stipel.** A ligule.

**Stirps.** Sum-total of genes in zygote which determine development of its descendant body-cells and germ-cells. **Race.** **Stock.**

**Stock.** (1) Race; strain; ancestry; stirps. (2) Trunk; stem; rhizome. (3) Pl. upon which a scion (*q.v.*) is attached in "budding" (*q.v.*). (4) Asexual part of organism which produces sexual part. See Zooid.

**Stoichiometry.** Study of laws of ch. combinations.

**Stokes's law.** W.-l. of fluorescent light is greater than w.-l. of exciting light. (Few exceptions called antistokes's lines.) See Fluorescence; Resonance.

**Stolon.** (1) Aerial branch, creeping stem, or "runner," which grows downwards into ground, roots, and throws up a new pl. *Ex.* grasses. (2) Common support of colony of zooids. (3) Extension of body-wall in anthozoa, etc., from which new individuals grow. **Cadophore.** Genital stolon.

**Stoma.** (1) *Bot.* Minute opening in epidermis (usually the under surface) of leaf leading to

air-spaces in mesophyll by means of which a pl. respire (i.e., effects gaseous interchange) and feeds (i.e., takes in carbon). (2) *Zoo.* Mouth; ostiole; spiracle. Plural, stomata.

**Stomach.** Part of alimentary canal between oesophagus above and duodenum below, and from wall of which gastric juice is poured out. Rumen. Paunch. Reticulum. Psalterium. Abomasum (q.v.).

**Stomodæum.** Primitive mouth. Fore-gut of tracheates. Gut leading to coelenteron. Fore-part of alimentary canal lined by ectoderm. Cf. Proctodæum. See Pituitary.

**Stone.** (1) Piece of rock; gem. (2) Calcareous mass in an organ; calculus. (3) Endocarp of drupaceous fruit. (4) Wt. of 14 lbs. *S. age.* Culture age preceding bronze and consisting of paleo-, eo-, and neolithic periods. *S. cell.* Sclereid.

**Strabismus.** Squint. Inco-ordination of eyeball muscles.

**Strain.** (1) Breed (q.v.). (2) Deformation. Bend. Twist. Tension. Compression. Change in a body, short of rupture, caused by stress (q.v.).

**Strangles.** Streptococcal disease of horses.

**Stratification.** Arrangement in more or less parallel layers. *App.* sedimentary rocks. **Stratosphere.** Upper isothermal layer of atmosphere (q.v.) beginning c. 6.8 miles up in temperate, 11 miles up in equatorial, and 4 miles up in polar regions. Below it is the tropopause and troposphere (q.v.). **Stratus.** Wide, horizontal sheet of cloud about 3000 to 6000 ft. altitude.

**Strays.** Elec. phenomena that interfere with correct reception of wireless waves by receiving sets. Atmospherics. See Interference.

**Streamline.** Direction of movement of fluid particles relative to a body passing through it. A curve the tangent of which at any point gives the direction of the vel. vector at that point. Symmetrical section of aeroplane giving max. thrust and min. drag.

**Strepsitene.** The twisted post-diplotene stage in meiosis. **Streptococcus.** Non-motile cocci arranged as a chain.

**Stress.** Force acting on contiguous surfaces of a body and tending to disarrange its particles. If forces act away from one another the stress is a *tension*, if parallel, a *shear*, if towards one another, a *pressure*. Cf. Strain.

**Stridulation.** Sound produced by friction of rough surfaces—e.g., between palp and chelicera (spider); metathorax and abdomen (cicada); between parts of fore wings (katydid); or between fore wing and hind leg (grasshopper).

**Strigil.** Comb-like structure on bee's (etc.) leg for cleaning antennæ. **Strigose.** Having bristles, hairs, or grooves.

**Strobila.** Strobila. *Zoo.* (1) Pile of disc-shaped embryos of scyphozoa. (2) Proglottides of tape-worm. *Bot.* (1) Spike (q.v.) of persistent membranous bracts each bearing a pistillate flower. (2) Cone. Cone-like mass of sporangia-bearing sporophylls. **Strobilation.** Reproduction by zooids formed from body-segments. **Strobilization.** **Strobile.** Stro-

**bila. Strobilization.** Strobilization.

**Stroma.** Ground-substance. Connective tissue framework of an organ.

**Strombuli-ferous, -form.** Spirally coiled.

**Strontium, ch. el.** Sr. Metal. *At. no. 38; at. wt. 87.63.*

**Strophiole.** Excrescence from testa of seed. Caruncle.

**Struggle for existence.** Competition between an organism and: (1) other organisms of its own kind (intra-specific s.f.e.); (2) organisms of different species (inter-specific s.f.e.); (3) physical surroundings (environmental s.f.e.).

**Struma.** Cushion-like swelling.

**Strychnine.** Poisonous pl. alkaloid.  $C_{21}H_{22}O_2N_2$ .

**Stupulose.** Covered with short hairs.

**Style.** (1) Mid-part of *pistil*, a columnar extension of *ovary* which carries at its summit the *stigma*. Part of insect antenna. A bristle-like structure; a bony or calcareous pillar. **Styliferous.** Having styles, bristles, etc. **Stylogonidium.** Conidium (*q.v.*). **Stylopodium.** Conical swelling at base of style. **Stylospore.** Conidium. **Pycnospore.** **Stylostegium.** Inner corona (*ex. milkwort*).

**Styptic.** Astringent. A local application that contracts blood-vessels and arrests hæmorrhage.

**Sub-atom.** An atomic constituent—electron, proton, neutron, negatron, positron, etc. **Subclavian.** Beneath clavicle. **Sub-encephalon.** Mid- and hind-brain.

**Suber.** Cork. **Suber-aceous, -ose.** (1) Cork-like. (2) Water-

proof. **Suberin.** Derivative of cellulose thickening cell-walls and making them water-tight.

**Subiculum.** Felted mass of hyphæ.

**Subimago.** Stage between pupa and imago. Active, winged instar. Pseudimago.

**Subjectivity.** Act of perception as *cf. c.* object perceived. Introspective consciousness.

**Sublimation.** (1) *Ch.* Direct vaporization of solid followed by direct condensation (*i.e.*, without liquefaction) of vapour to a powdery solid. (2) *Psy.* Changing a primitive impulse, or primitive trend of mental complexes, so that it is compatible with existing social order. *Cf.* Inhibition. **Subliminal.** Below "threshold" of consciousness. *Per.* stimuli too weak to arouse sensation or response.

**Sublingua.** Hard plate beneath tongue of cert. mammals (*ex. lemur*) which probably represents the older reptilian tongue. **Submicron.** A particle visible only through ultra-microscope, ranging from  $10^{-5}$  cm. to  $5 \times 10^{-7}$  cm.

**Substance.** (1) Matter. (2) Matter and energy. (3) The real basic essence of matter and energy independent of human thought. (4) That which underlies matter and energy apart from the attributes sensed by living beings.

**Subtend.** To extend beneath or opp. to; to occupy an adjacent position; to enclose. **Subul-ate, -iform.** Tapering.

**Succiferous.** Sap-conveying.

**Succise.** Ending abruptly, as though a part were cut off.

**Succubous.** Condition when bottom of each leaf overlaps top of leaf immediately below. *Cf.* Incubous.

**Succus.** Gland or pl. juice. Sap. Intestinal secretion.

**Sucker.** (1) Underground stem which produces a collateral and independent pl. (2) Organ for producing a partial vacuum for ingestion or prehension. *Ex.* aboral disc-shaped end of hydra; *acetabulum* on arm of octopus. Prehaustorium. Surculus. Soboles.

**Sucroclastic.** *Per.* breaking down of complex carbohydrates (starch, sucrose) into simpler ones (glucoses). **Sucrosa.** Cane or beet sugar.  $C_{12}H_{22}O_{11}$ . Saccharose.

**Suction.** Creation of a partial vacuum. **S.-pump.** The common pump which, by the formation of a partial vacuum, enables the p. of the atmosphere to raise water to a height of about 20 ft. It is really a suction-and-force pump. Since, section for section, the wt. of the atmosphere is equal to the wt. of a 30 in. column of mercury, or of a 34 ft. column of water, the theoretical height through which water can be "sucked" is 34 ft.

**Sudburian, geo.** Lowest part of neo-laurentian div.

**Sudor.** Sweat. **Sudoriferous.** *Per.* sweat-glands.

**Suffrutex.** Short undergrowth. Sub-shrub.

**Suffusion.** Spread of fluid into surrounding tissues.

**Sugar.** Sweet, crystalline product of pl. Dextrose; sucrose; glucose; maltose.

**Sug-ent, -escent.** Suctorial.

**Sulcate.** Furrowed, grooved,

fissured. **Sulcus** *lunatus.* Simian fissure (*q.v.*).

**Sulphate.** Salt or ester of sulphuric acid. **Sulphophilous.** *App.* organisms capable of using energy of sulphur compounds to build up organic matter. *Cf.* Carbophilous. **Sulphur, ch. el.** S. Non-metal. *At. no.* 16; *at. wt.* 32.06.

**Summer eggs.** Thin-shelled, quickly-developing eggs of cert. f.-w. fauna which are deposited in early summer. Eggs of rotifers which are formed without fertilization. *Cf.* Winter eggs.

**Sun.** Luminous, hot, parent body of our planetary system.

The s. is 92,900,000 miles distant; weighs 332,000 earths or  $1992 \times 10^{34}$  tons, has a density 1.41 (water 1.0), a surface temp. of 6000° C. and an internal temp. of many millions of degrees C.; its surface gravitation is 442.4 ft. per sec. or 27.5 times that of earth; its d. is 864,000 miles, it rotates once in 25.32 days, and is translating through space, with all its planets, at 11.5 miles per sec.

**Sun-spots.** Dark areas on sun's surface which suddenly appear and gradually, after a period varying from weeks to many months, disappear. Their size may be anything up to 100,000 miles in d. Their numerical max. is cyclic occurring every 11.13 years. *See* Faculae.

**Supersaturation.** A solution which, after saturation with a soluble substance at b.p., remains liquid—i.e., has not deposited crystals on cooling. **Supervolute.** Having a rolled and plaited arrangement in the bud. *Ex.* convolvulus.

**Supination.** Inclined backward. Movement of fore-arm that turns palm upward. *Opp.* pronation.

**Suppuration.** Formation of pus.

**Suprarenal body.** Adrenal body (*q.v.*). Epinephros. *See* Chromaffin.

**Sural.** *Per.* calf of leg.

**Surcu-ligerous, -lose, -lous.** *Per.* pl. that start as suckers.

**Surculus.** Sucker (*q.v.*).

**Surd.** Not expressible in integers. *Ex.* pi.  $\sqrt{3}$ .

**Surface tension.** Resultant at a surface of all attractive forces. Capillarity.

The surface of a freely-exposed liquid is covered with a very thin layer having physical properties that differ from subjacent layers. A mol. in centre of liquid is subjected to cohesive attraction of mols. on all sides, attractions which therefore neutralize one another. A mol. on surface has no compensating upward pull to the downward one; the resultant p. is normal to the surface of the liquid and mechanically acts like an *elastic membrane* tending to diminish the surface and to bring any given vol. into a form with a min. superficial area. Another factor differentiating surface mols. from depth mols. is the greater concentration of a solute at the surface as *cf.* c. that in deeper parts, a circumstance that causes "*adsorption*" (*q.v.*). S.t. plays a most important part in life phenomena, and it is significant that the s.t. of water is greater than that of any other liquid except mercury. *See* Capillarity.

**Survival of fittest.** A principle [resulting from *Natural Selection* (*q.v.*)] that in the long run the "fittest" survive and the least fit perish. Natural Selection compels adaptation, and in the competition between the adaptable and non-adaptable the latter are eliminated.

**Suspension.** Buoying up of minute insoluble particles by a liquid. Suspended particles are arrested by a filter (unless they are smaller than its pores);

dissolved particles pass through. *See* Solution.

**Sustentacular.** Supporting.

**Suture.** (1) Line of junction of two organs or parts, as of skull bones. Raphe. Dehiscence line. (2) Surgical stitch.

**Swarm-spore.** Zoospore.

**Sweat.** Perspiration. **Sudor.** Water and waste products excreted by sweat-glands. **S.-glands.** Sudoriferous glands. Skin-glands that excrete waste products and water and, by evaporation of latter, prevent undue rise of temp.

**Swim-bladder.** Air-bladder (*q.v.*) of cert. fishes formed as an outgrowth from gut.

In dipnoi, besides its hydrostatic function, it acts as an accessory breathing organ or incipient lung. Absent in sharks and flat-fish.

**Swimming ovaries.** Ripe ova that float about in body-cavity of *acanthocephala*. **S.-plates.** Comb-like plates which act as propellers. Ctenophores. *See* Ctenophora.

**Switch.** Apparatus for connecting ("making"), disconnecting ("breaking"), or changing route ("shunting") of electric current.

**Syconi-um, -us.** Multiple, succulent, receptacular fruit.

**Symbi-on, -ont, -ote.** Partner in a symbiotic alliance. *Cf.* Parasite. **S.-osis.** Conjoint life of two organisms of different species in which each benefits the other; it may be between an. and an., an. and pl., or between pl. and pl.

In lichen a fungus protects and attaches an alga to a tree or rock, etc., and provides it with salts and moisture. By its chlorophyll the alga builds up carbonaceous matter (sugars, etc.), a part of which it turns over to the fungus. *Mycorrhizas* do

much the same for oak, beech, and other large trees. Other examples are hydra and alga; infusoria and white ant; jelly-fish and fish; sea anemone and crab; root-nodule bacteria and pea. *Syn.* lichenism. *Cf.* Helotism; Commensalism; Endoparasite; Parasitism. *See* Myco-, Rhiza-trophic.

### Symbols and signs.

Å, Angström unit. b.p. boiling point. e.c. or cu. cm. cubic centimetre. d. diameter. ft.<sup>2</sup> square foot. ft.<sup>3</sup> cubic foot. g. acceleration due to gravity.  $g_{45}$ , ditto at lat. 45°. gm. gramme. h. Planck's constant, or quantum of action,  $6.624 \pm 0.0088 \times 10^{-27}$  erg. sec. in.<sup>2</sup> square inch. in.<sup>3</sup> cubic inch. K. Absolute Centigrade scale of temp. Kg. kilogramme. Km.<sup>2</sup> square kilometre. Km.<sup>3</sup> cubic kilometre. l. length. m.<sup>2</sup> square metre. m.<sup>3</sup> cubic metre. ml., millimetre. m.<sup>+</sup> mass of low vel. electron. m. mass of hydrogen atom. mg. milligramme. micro, prefix denoting  $10^{-6}$ . micro-micro, ditto  $10^{-12}$ . milli, prefix denoting  $10^{-3}$ . milli-micro, ditto  $10^{-9}$ . mm. millimetre. mm.<sup>2</sup> square millimetre. mm.<sup>3</sup> cubic millimetre. mol. molecule. m. p. melting point. myria, prefix denoting  $10^4$ . N, Avogadro's no.,  $6.084 \times 10^{23}$  per gm.-mol.  $N_{\infty}$  Rydberg's constant,  $109732.42 \pm 0.06$  cm.<sup>-1</sup> (for infinite mass). n., Loschmidt's no.  $27 \times 10^{23}$ , the no. of mols. in a c.c. of any gas at standard temp. and p. r. radius. S. entropy. T. temp. on abs. scale. t. temp. on Centigrade scale. V. v. volume. vel. velocity.  $\lambda$ , lambda, wave-length.  $\Sigma$ , sigma, summation of.  $\pi$ , pi 3.14159265... + plus, pos. - minus, neg.  $\pm$   $\mp$  plus or minus, pos. or neg.  $\times$  or  $\cdot$  multiplied by.  $\div$  or  $:$  or  $/$  divided by.  $=$  or  $::$  equals.  $\approx$  equals, or, as  $\approx$  identical with.  $\sim$ , or  $\approx$  approximately equal to.  $\rightarrow$  or  $\Rightarrow$  approaches.  $>$  is to, ratio of, divided by.  $<$  greater than, above.  $<$  less than, below.  $\propto$  varies as.  $\neq$  or  $\neq$  is not equal to.  $\sim$  difference between.  $\perp$  continued product of numbers.  $\infty$  infinite.  $\therefore$  therefore.  $\because$  because, since. ... and so on. % per cent. ‰ per thousand or 0.1%.  $\angle$  angle.  $\parallel$  right angle.  $\parallel$  parallel to.  $\bigcirc$  circle; circumference; 360°.  $\triangle$  triangle.  $\frown$  arc.  $\square$  square.  $\sqrt{\quad}$  square root.  $\sqrt[3]{\quad}$  cube root.  $\int$  integral. *See also* S.L.

**Sympathetic nervous system.** Nerves and ganglia controlling viscera and blood-vessels.

**Symphiles.** Guest-parasites. Myrmeco-, termito-philous. *See* Parasitism. **Symphily.** Commensalism wherein each party benefits from the association. *Cf.* Synecthy. **Symphyantherous.** Synantherous. **Symphyllous.** Monophyllous; Gamophyllous (*q.v.*). **Symphyogenesis.** Origin of one organ by union of other organs. **Symphysis.** Osseous, cartilaginous, or ligamentous junction between two bones. Coalescence. Amphiarthrosis. *Cf.* Syndesmosia. **Symplasm.** Inchoate mass of micro-organisms. All living matter regarded as a genetically-related unity continuous in time. **Symplast.** Multinucleate mass of protoplasm formed by repeated nuclear fissions. **Sympodial.** Type of growth where branch extends by development of lateral bud. *Cf.* Monopodial. **Sympodium.** Cymose inflorescence in which main axis ends in a flower and a side branch takes its place. There are three types: mono-, di-, and plero-chasium (*q.v.*).

**Synac-me, -my.** Acting together. Cumulative. **Synchronous** maturation of stamens and pistil. Simultaneous ripening of andræcium and gyncæcium. **Synanthesis.** **Synangium.** Compound sporangium with coherent sporangia. **Synantherous.** Having anthers inserted in tube form. **Syngenesious** anthers. **Symphyantherous.** **Synthesis.** **Synacmy** (*q.v.*). **Synanthous.** (1) Having leaves and flowers

**synchronous.** (2) *Per.* **Syn-anthy.** Fusion of normally separate flowers. **Synaposematic.** Mimicry in which defenceless species imitate species armed with lethal devices. *Cf.* **Aposematic.** **Synapse.** Nexus or site of contact between two neurons across which impulses pass. **Synapsis.** Syndesis. **Synizesis.** Chromosome pairing at zygotene prior to nuclear reduction. Conjugation, in meiosis, of pairs of homologous chromosomes of maternal and paternal origin respectively, a stage preceding first maturation div. **Synaptene.** Zygotene stage in meiosis. **Synarthrosis.** Joint in which bone surfaces are united by fibrous connective tissue or by hyaline cartilage so that movement is inappreciable. **Synchondrosis.** *Cf.* **Symphysis.** **Syncarp, -ium.** Collective fruit with carpels of gynoecium united in a compound ovary. **Syncerebrum.** Arthropod type of brain wherein ventral cord ganglia are united with main brain. **Synchondrosis.** **Synarthrosis.** **Syncladous.** With tufted branchlets. **Synclastic.** Having curved *convex* surface. Having surface which, in all directions, bears away from a tangent plane. *Opp.* **anticlastic.** **Synclin-al-e.** *Per.* strata twisted into a trough or basin. **Syncoelom.** (1) Coelom formed by fusion of one or more pairs of primitively separate coelomic cavities. *Ex.* fish. (2) Collective serous spaces of trunk. **Synconium.** Hollow inflorescence axis. *Ex.* fig. **Syncope.** Partial or complete unconsciousness following sudden

lowered action of heart. **Syn-cryptic.** Resemblance of an. of different kinds one to the other through common protective mimicry of environment. **Syncytia, Syncytiotrophoblast, Syncytium.** (1) A multinucleate mass of protoplasm in which no cell-walls are definable. **Plasmodium.** **Cœnocyte.** (2) Massed cells of outer stratum of trophoblast (*q.v.*) of ovum which act phagocytically on mucous membrane of uterus (decidua) and so provide early embryo with food. **Syndactyl-ism, -y.** Having fused digits. **Syndesis.** **Synapsis** (*q.v.*). **Syndes-mology.** Study of joints. **Syndesmosis.** Joint of closely-fitting bony surfaces permitting of slight movement only. *Cf.* **Symphysis; Amphiarthrosis.** **Syndiploidy.** Nuclear conjugation resulting in doubled chromosome no., occurring especially in divs. immediately preceding meiosis. **Syndrome.** Totality of signs and symptoms characterizing a disease. **Synecthrans.** Commensal parasite (*q.v.*) tolerated by host as an undesirable guest. **Syn-ecthry.** Commensalism wherein guest is treated hostilely by host or in which there is mutual "dislike." *Cf.* **Symphily; Synœcete.** **Synedra.** Growing on angles of stem. **Syn-ema.** Column formed by conjoined stamen filaments. *See* **Syngenesious.** **Synerg-etic, -ic.** Acting together. (1) *App.* muscles which combine with "prime movers" and "fixers" in muscular action. Co-ordinated action of groups of muscles, some of them antagonistic, to produce a specific movement.



(2) *App.* co-operative action of two or more drugs as *cf.* c. antagonistic or antidotal action. *See* Synergist; Synergism. **Synerg-ids, -idæ.** Cert. "cells" which (with the oosphere) are next the micropyle and arise from the micropylar cells. They are the two outer nuclei (not separated by cell-walls) of cert. three nuclei at micropylar end of embryo-sac (*q.v.*) in ripe ovule (*q.v.*) of cert. pl. (*Ex.* lily). The inner nucleus is the oosphere (*q.v.*). *Syn.* help-cells. **Synergism.** (1) Muscle co-ordination. (2) Co-operative action of two or more drugs that is greater than the sum of effects of the same drugs administered separately. *See* Antagonist; Synergetic. **Synergist.** A "fixing" muscle which aids some other action—*e.g.*, extensors of wrist are synergists of clenchers of fist. A muscle that acts synchronously with another muscle. *See* Synergism; Synergetic. **Synesthesia.** The arousing in one part of the body of a sensation by a stimulus app. to another part of the body. *Cf.* Synkinesis. **Syngamy.** Sexual union of m. and f. gametes. Cell-conjugation. Fertilization. Pollination. Also app. to promiscuous cross-fertilization between related pl. flowering at same time.

There are two types: (1) *isogamy*, where cells are of equal size; (2) *anisogamy*, where cells are of unequal size, the f. cell, oosphere or megagamete, being sometimes hundreds of thousands of times larger than the m. cell or microgamete. The resulting cell of the union is a zygote or oosperm.

**Syngenesious.** Having stamens united by anthers as a cylinder. **Synantherous.** *See* Synema.

**Syngenesis.** Sexual reproduction. Reproduction in which the zygote is formed by the union of a m. el. and a f. el. **Syngnathidæ.** Fishes with paired jaws (or jaw-plates) and tubular mouths. *Ex.* seahorse. **Synizesis.** (1) Intracellular chromatin aggregation prior to div. at maturation. (2) Inflammation around an orifice—*e.g.*, of pupil. **Synesis.** Synapsis. **Synkaryon.** Zygote nucleus. **Synkinesis.** Involuntary movement of one part of body when another part is moved. *Ex.* contraction of jaw-muscles when cutting a tough object with scissors. *Cf.* Synesthesia. **Synochreate.** Having stipules ensheathing stem. **Synœcete.** Synœkete. **Synœcious.** (1) Having pistillate and staminate flowers on same head (*ex.* compositæ). (2) Having archegonia and antheridia in same receptacle (*ex.* moss). *Per.* synœcism. **Syn.** synœcious. **Synœc-ism, -y.** Association (commensalism, *q.v.*) in which a host tolerates a guest but derives no apparent benefit from it. *Cf.* Synechthry. *See* Synœkete. **Synœkete.** Synœcete. A guest tolerated by host. *Cf.* Synechthrans. *See* Synœcism; Parasite. **Synoicous.** Synœcious. **Synos-teosis, -tosis.** Anchylosis (*q.v.*). **Synovia.** Viscid, glairy secretion of synovial membrane. **Synovial fluid.** Synovia. Fluid lubricating joints which is secreted by delicate connective tissue lining joint surfaces called the **Synovial membrane.** **Synovitis.** Inflammation of joint. **Synsepalous.** Having calyx formed by united sepals.

**Gamosopalous.** **Synspermous.** Having united seeds. **Synsporous.** Propagation by exchange of cell-contents. *Ex.* alga; *spirogyra*. **Syntechnic.** Resemblance between an. of different species due to common environment. **Convergence.** **Synthermal.** Having same temp. **Synthesis.** Building up. **Aggregation.** Combination of atoms to form a mol. **Combination of mols.** to form a compound. **Formation of atoms by union of subatoms.** *Opp.* analysis. *See* Photosynthesis. **Syntony.** (1) Responsiveness to environmental stimuli. (2) Resonance. (3) Equality of frequencies. **Syntrophic.** Biological interdependence, as in cells of a multicellular organism. **Syntropy.** Serial symmetry in which there is no reversion of parts. **Dextorse.** *Opp.* antitropy (*q.v.*).

**Syphilis.** Contagious disease caused by a protozoon, *Spirochaeta pallida*.

**Syringeal.** *Per.* syrinx.

**Syringium.** Any squirting apparatus of an organism. **Syrinx.** "Song-box" or vocal organ of birds.

The s. is *not* a part of larynx (*q.v.*), but is a modification of the trachea (*q.v.*) or bronchi, or both, and lies at the base of the wind-pipe. It contains membranous folds the vibrations of which cause the notes.

**System.** (1) Collection of organs the united action of which provides some vital function. *Ex.* nervous s. (2) A group of united zooids. (3) The body as a functional whole. (4) An orderly group of bodies. *Ex.* solar s.

**Systole.** Contraction of heart-muscle or of other contractile, propulsive organ. *Opp.* diastole.

**Syzygial.** *Per.* syzygium. **Syzygium.** (1) Two to five adherent gregarine protozoa. (2) Close union of two adjacent limbs. *Ex.* crinoids. (3) Union of ossicles by calcified fibres. (4) Chain of spores of sporozoa. **Syzygy.** Syzygial state.

## T

**Tachometer.** Instrument for measuring revolutions.

**Tachy-genesis, -gony.** Ontogenetic, with shortening of phylogenetic development —*i.e.*, development with omission of cert. embryonic stages. *Ex.* cert. frogs and toads hatch direct from egg without a tadpole stage. *Cf.* Canogenesis; Palingenesis.

**Tactic.** *Per.* taxis.

**Tadpole.** Larva of amphibians.

**Tænia.** Tape-worm. **Tæniate.** Ribbon like. Resembling

a tape-worm. **Longitudinally-striped.** **Tænidia.** Spiral threads strengthening trachea.

**Tagmata.** Membranous structures in precipitates. **Micellæ.** Segments—pro-, meso-, and meta-soma. Prolongation of rear end of an. adapted for locomotion or prehension.

**Tail.** A terminal extension of the backbone. In *origin* the tail was an organ of propulsion and steering as seen in fishes. *See* Coccyx; Hominidæ.

**Tail-fin.** See Diphy-, Geophyro-, Hetero-, Homo-cercal.

**Talc.** Silicate of magnesium.  $H_2Mg_3(SiO_3)_4$ .

**Talgai.** *Per.* skull of proganathous proto-Australian.

**Tangent.** (1) Line touching curve without cutting it when produced. (2) Quotient of sine/cosine of angle.

**Tannin.** Gallo-tannic acid,  $C_{14}H_{10}O_8 + 2H_2O$ . Astringent substance of gall-nuts.

**Tantalum, ch. el. Ta. Metal.** *At. no.* 73; *at. wt.* 180.88.

**Tapetum.** (1) Nutritive layer investing sporogenous tissue. (2) Part of *corpus callosum*. (3) Any membranous layer. (4) Reflecting and refracting layer in choroid at back of eye of many an. which causes the eye to appear to shine in the dark. It contains *guanine* crystals. It is absent in man and primates. The *tracheal* mirror of insects.

**Tap-root.** Primary, usually vertical, root from which lateral roots arise.

**Tardigrada.** Mite-like hermaphrodite arthropods. Water bears.

**Tarsius.** Small, nocturnal, goggle-eyed, arboreal primate akin to lemurs.

According to Prof. Wood-Jones the genealogical line, starting in the first ancestral primate and culminating in man, passes through the *tarsioides*. The majority of anthropologists, however, consider that this line passes through the *anthropoidea*, a view corroborated by Sir Arthur Keith, who has stressed the fact that man shares 53 characters with Old World monkeys, 60 with monkeys of the New World, 56 with the orang, 84 with the gibbon, 87 with the gorilla, and 98 with the chimpanzee.

**Tarsus.** Ankle bones between leg-bones and metatarsus.

The "shank" (tarso-metatarsus) of birds. Distal part of arthropod limb; lowest joint of pedipalp. Insect foot below tibia. Gristly plate of eyelid. Basipodium.

**Tartar.** Acid potassium tartrate; argol.  $KHC_4H_4O_6$ . T. emetic. Poisonous mordant; potassium antimony tartrate.  $KShOC_4H_4O_6$ . Tartareous. Having a rough, crumbling, surface. Tartaric acid. Acid of fruits.  $C_4H_4O_6$ .

**Taste-bud, -bulb.** Tongue end-organ composed of t.-cells. Gustatory calyculus. See End-organ; Tongue. T.-cell, -corpuscle. Cell of t.-bud. T. cup. Gustatory sensilla. T. organ. t.-bud. Groove of Hatschek.

**Taungs.** *Per.* skull of extinct S. African anthropoid, *Australopithecus*.

**Tautomerism.** Reaction of two identical, but not isomeric, compounds as if they possessed different structural formulæ; it is regarded by some as a reversible isomeric change.

**Tax-is, -y.** Tendency of organisms to move as a whole (*Cf.* tropism) towards (+) or away from (-) a stimulus source. *Ex.* aëro-, baro-, chemo-, galvano-, geo-, hydro-, photo-, phyllo-, pneumo-, rheo-, stereo-, thermo-, thigmo-, tono-taxis (*q.v.*). **Taxonomy.** Classification of an. and pl. according to their actual (natural) relationships. Biotaxy.

**Tear gas.** Bromo-acetone and benzyl bromide.

**Tears.** Secretion of lachrymal glands; a physiological saline solution of sodium chloride and salts of potassium, calcium, and magnesium.

**Tectology.** Study of organisms as a group of morphological units—morphons—as distinct from physiological units. *See* Bion; Morphon.

**Tectospondyly.** Having concentric calcified rings in vertebral centra.

**Tectrices.** Wing- and tail-coverts.

**Teeth.** *See* Tooth.

**Tegmen, Tegmentum.** *Syn.* tegumen. Covering. Integument; inner seed-coat; endopleura; bud-scale; part of mid-brain; ninth abdominal m. insect tergite; calyx cover of oral surface of blastoids and crinoids; ant. wing of cert. insects; bony plate over tympanic antrum; valve-cover in polyplacophora; chondrocranium; hemielytrum. **Tegula.** Any tile-like organ. Flap on mesothorax of butterflies. Lobe on wing-base of flies. Fore-runner of elytrum; alula; scapula; scale-patagium; parapteron; pteryopod; squama; antisquama. **Tegumen.** Tegmen (*q.v.*).

**Teinoscope.** Prism telescope correcting chromatic aberration.

**Tela.** Tissue; web. **Telar-ian.** Web-spinning. *Ex.* spider. **Teleony.** Supposed influence of former m. parent on offspring subsequently born to same f. **Telegraph plant.** *E. India* *Desmodium gyrans*, the leaflets of which move up and down like a semaphore. **Teleianthous.** Possessing andro- and gynoecium. Monoclinous. Hermaphrodite. **Telencephalon.** Ant. of two parts of fore-brain. End-brain. Neo-, pros-encephalon. *See* Optic vesicles. **Teleology.**

System that postulates *design*—i.e., purposive and intelligent causes—in nature. *Opp.* dysteleology, mechanism. **Teleophore.** Gonangium. Case enclosing medusa. Gonotheca. **Teleosis.** Supposed teleological evolution. **Teleosts.** Modern bony, scaly fishes. **Telepathy.** Supposed thought-communication from one brain to another. **Telephone.** Instrument converting varying sound-waves into varying electric currents and these back into varying sound-waves. **Telescope.** Instrument for enlarging distant objects. *Reflecting t.* has concave object-mirror and convex eye-glass; *Refracting t.* has convex object-, and concave eye-glass. **Teleutobud.** Teleutogonidium. **Teleutoform stage.** Telostage (*q.v.*). **Teleutogonidium.** Winter-spore. Winter egg (*q.v.*). **Teleutobud.** Teleutospore. **Teliospore.** *Ex.* rust. **Teleutosore.** Rust sorus of previous summer. **Telium.** **Teleutospore.** Rust. Winter-spore. **Teleutogonidium.** **Teliospore.** **Television.** Reproduction of scenes at a distance by conversion of light into electromagnetic waves and of these back into light. **Telia.** **Teleutosores.** **Teliospores.** **Telic.** *Per.* teleosis. **Teleological.** *Cf.* Eclectic. **Teliospore.** **Teleutospore.** **Teliospore.** **Telespore.** Summer-stage of rusts. **Teleutoform stage.**

**Tellurium, ch. el.** **Te.** Non-metal. *At. no.* 52; *at. wt.* 127.61.

**Teloblasts.** Rapidly-growing embryonic cells. **Telokinesis.** Nucleus, and daughter-nuclei, arrangement in post-

**telophase** (*q.v.*) stage. **Telolecithal**. *App.* egg with abundant yolk mostly at vegetative pole. **Amphiblastic**. *Ex.* fish. **Telolemma**. Covering of muscle nerve-end organ. **Telomitic**. Having chromosomes attached end-wise to spindle-fibres. **Telophase**. Last stage of meiosis (*q.v.*) when movements of chromosomes cease and daughter-nuclei are completed. **Telokinesis**. **Telosynapsis**, **-syndesis**. End-to-end union of half-chromosomes. **Meta-**, **telo-syndesis**. *Cf.* **Parasynapsis**. **Telotaxis**. Orientation to a *selected* stimulus source. **Telotroch**. Preanal tuft of cilia of trochosphere (trochophore).

**Telson**. Terminal segment of arthropods and worms; also of crustaceans when it bears bristle-plates.

**Telum**. Last abdominal segment of insects. *Dart*.

**Temnospondylous**. Having vertebrae composed of three pairs of separate units. **Rachitomous**. *Cf.* **Lepo-**, **Stereospondylous**.

**Temperature**. Measurable degree of hotness of a body. There is no known upper limit—*e.g.*, surface t. of sun is 6000° C., and interior t. of stars is calculated to be 55,000,000° C. The lower limit is the *Abs.* Zero or -273.16° C. or -459.72° F. when all mol. movements cease. *See* **Absolute t.** **T. coefficient**. A no. representing a change in t. and a simultaneous change in some other property—*e.g.*, increase in resistance to an elec. current per deg. C. rise in t. **T. conversion**. C. Centigrade; K. Kelvin or Absolute; F.

Fahrenheit; R. Réaumur;  $\alpha$ , degrees for conversion.

C. = 1.8° F. = 1.0° K. = 0.8° R.

$\alpha^\circ$  C. =  $\frac{5}{9}$  (F - 32) =  $\frac{1}{9}$  R.

F. = 0.55556 C. or approx.  $\frac{1}{2}$  C.

$\alpha^\circ$  F. =  $\frac{1}{2}$  C. + 32 =  $\frac{1}{2}$  R. + 32.

R. = 1.25 C. = 2.25 F.

$\alpha^\circ$  R. =  $\frac{1}{2}$  (F - 32) =  $\frac{1}{4}$  C.

K. or Absolute Centigrade scale.

$\alpha^\circ$  K. = C. + 273.18.

Freezing pt. water, 0° C., 32°

F., 0° R., 273.18° abs. Boiling

pt. water, 100° C., 212° F.,

80° R., 373.18° abs. T., critical.

The highest t. at which pressure

(p.) can liquefy a vapour.

The vapour p. at the critical t.

is the *critical pressure* and the

vol. occupied by a gramme of

the substance is the *critical*

*volume*. *See* under **Critical**.

**Tenacity**. Resistance offered

to force tending to pull particles

asunder. **Cohesiveness**.

**Tensile strength**.

**Tendon**. Tough fibrous cord

or band connecting muscle to

bone or other parts. **Sinew**.

**Aponeurosis**. **Tendril**. Twin-

ning, modified leaf, **stem-axis**,

sucker, axillary branch, or

stipule, by which climbing

plants support themselves.

**Tension**. (1) Force tending

to cause extension. *Opp.* pressure.

*See* **Stress**, **Surface t.**

(2) Property whereby an elec-

tric charge tends to discharge,

and which varies as the square

of the quantity of elec. on a

given area. (3) Elec. "pres-

sure," voltage, potential.

**Tentacle**. Slender flexible or-

gan on head of cert. an., for

feeling, prehension, etc.

"**Arm**" of cuttle-fish; stalked

eye of snail; hair of sundew;

stinging-thread of jelly-fish.

Palpae. Tentillum. Pin-nule. Vibrissa. Hapteron. Tube-foot. Tentaculocyst. Sense-organ (modified tentacle) of coelenterates. Rhopalium. See Lithite; Statorhab. Tentaculozoid. Specialized prey-seizing "individual" of hydrozoan colony. See Zooid. Tentillum. Tentacle branch.

Teratism. Anomaly of form and structure. Teratology. Study of malformations, monstrosities, and maldevelopments in pl. and an. Teratoma. Growth or tumour of mixed tissues.

Terbium, *ch. el.* Tb. Metal. *At. no.* 63; *at. wt.* 159.20.

Terebra. Univalve mollusc. Wood-boring ovipositor. Terebrant. Wood-boring.

Terete, Teretial. Cylindrical and tapering.

Tergal. *Per.* tergum. Tergum. Back; dorsum; notum; tergite.

Termitarium. Colony, or mound-like dwelling, of termites. Termites. White "ants." Social insects of the O. *isoptera*. Termitophiles, -lous. Social parasites (or *per.* them) living in termitarium. See Parasite.

Terrace, *geo.* Narrow, steep-fronted level bordering a river, lake, or sea.

Tertiary. (1) Div. of *cenozoic* era following *mesozoic* and preceding *quaternary*. It is div. into a later *neogene* (*miocene* and *pliocene*) and an earlier *palaeogene* (*eocene* and *oligocene*) period. (2) *Per.* wing-feathers of humerus. Scapular. Tertial.

Test. (1) Testa (*q.v.*). (2) An. covering. Grey, tough, cellulose-containing coat of

tunicates protecting and attaching them. Shell. Mantle. House. Testa. (1) Test (*q.v.*). (2) Seed-integument or coat. Epispem. T.-cells. Karyomocytes (*q.v.*). Testaceous. Of a brick-red colour. *Per.* test. Testicle, Testis. M. reproductive gland that produces sperms and hormones. It corresponds with f. ovary. M. gonad. Milt. Testudinate. Having a hard shell. *Er.* tortoise.

Tetan-us, -y. (1) Disease caused by t. bacillus in which spasmodic muscular contractions occur. Lockjaw. (2) Muscle contraction induced by toxins or by faradism. (3) Pl. rigidity. See Clonus.

Tetrabasic. Having four replaceable H atoms. Containing four univalents.

Tetrad. (1) Quartet of cells or of chromatids or of spores. (2) Chromosome div. into four parts. (3) Quadrivalent atom or radicle. See Valency. Tetradynamous. Having four long and two short stamens. Tetragon. Plane-faced figure with four angles. Tetragynous. Having four carpels to gynoecium. Tetrahedron. Solid figure enclosed by four triangles. A regular t. is the *hemihedron* of a regular octahedron. Tetralophodont. Having four ridged molar teeth. Tetralophous. Having four crested rays. Tetramerous. In multiples or sets of four, four-jointed. Tetrandrous. With four stamens. Tetraplant. Tetraploid. Tetraploid. Having four times the basic no. of gametic chromosomes—i.e., twice the diploid no. A cell with a tetraploid chromosome.

**Tetraplant.** See Polyploidy.  
**Tetrapterous.** Four-winged.  
**Tetrapyrenous.** *App.* fruit with four stones. **Tetraquetrous.** *App.* four angled stem.  
**Tetrarch.** Having four protoxylem bundles. **Tetrasomic.** *App.* cell with four chromosomes of one type. **Tetrasporangium.** Sporangium producing tetraspores. *Ex.* red seaweed. **Tetraspores.** Quartet of non-motile spores of tetrasporangium. **Tetrasporocystid.** Oocyst with four sporocysts. **Tetraster.** Mitosis (in polyspermy) with four (instead of two) astral poles. **Tetrastichous.** In four rows. **Tetrathecal.** Having four loculi. **Tetravalent.** Quadrivalent. **Tetrazoic.** Having four sporozoites. **Tetrazoid.** Zooid developed from each of four parts constricted from a process of stolon. First blastozooid, which later becomes the ascidiozooid.  
**Thalamencephalon.** Hinder part of fore-brain. Diencephalon. Between-brain. See Telencephalon. **Thalamifloral.** With stamens inserted in receptacle free from calyx. **Thalamus.** (1) Part of diencephalon. (2) Thallus. (3) Torus. (4) Flower-receptacle. Upper part of stem from which flowers arise. **Thalassin.** Toxin of sea-anomones, etc. **Thalline.** Like a thallus. Crystalline antipyretic salt.

**Thallium, ch. el.** Tl. Metal. *At. no.* 81; *at. wt.* 204.390.

**Thallophytes.** Cryptogamous pl. Stemless, rootless, leafless pl., including bacteria, algae, fungi, and liverworts. From *thallos*, a young shoot, and *phyton*, plant.

In higher types the pl. body is a

plate of cells called the *thallus*. *Cf.* Cormophyte.

**Thallus.** Plate-like mass of cells forming main part of higher thallophytes (*q.v.*). It presents no differentiation of root, leaf, and stem, but bears the reproductive organs *archegonia* and *antheridia*. *Syn.* blastema. *Cf.* Mycelium. **Prothallus.** **Thamnium.** Branching thallus of lichens.

**Thanatoid.** Deadly. *App.* poisonous snakes. **Thanatosis.** Death-mimicry for protective purposes. *Akinensis.* Death-feigning. *Cf.* Aposematic.

**Theca.** Case. Protective covering, as of pupa, chrysalis, worms, zooids, corals, spores. Sheath of proboscis, or of spinal cord, or of Graafian follicle. Sporangium. Moss-capsule. Pollen-sac. Ascus. Hydrotheca. Wall of calicle. Dorsal cup of crinoid calyx. **Thecaphore.** Support of theca. **Gynophore** (*q.v.*). **Thecaspor.** Case-enclosed spore. **Ascospore.** **Thecium.** Organ containing sporules. Fertile part of apothecium. **Hymenium.** **Thecodont.** Having socketed teeth.

**Thee-lin, -lol.** Two hormones in f. mammals with oestrus- and growth-promoting functions. **Estrin.** **Thelium.** Nipple. Papilla. **Thelyblast.** Mature f. gamete (*q.v.*) or germ-cell. F. genoblast. **Thelytoky.** Parthenogenesis (*q.v.*) in which only f. are produced. *Ex.* sawflies. *Cf.* Arrhenotoky. **Thelyplasm.** F. plasm. *Opp.* arrhenoplasm (*q.v.*).

**Thena-l, -r.** *Per.* palm and "ball" of thumb. **Palmar.**

**Theorem.** Principle. Law.

**Truth.** Established fact. **Rule.** **Theory.** A generalization not absolutely proved, less certain than *law*, more certain than *hypothesis* (*q.v.*).

**Therapeutics.** Science of disease remedies.

**Theriodonts.** Triassic and permian reptiles of Africa with differentiated teeth.

**Thermal capacity.** No. of heat units required to raise a substance through  $1^{\circ}\text{C}$ . **T. conductivity, coefficient of.** Quantity of heat in calories which passes in 1 sec. between two opp. faces 1 cm. apart of a cube of the substance maintained at a constant difference of temp. =  $1^{\circ}\text{C}$ . **T. efficiency.** Ratio of heat utilized by engine to total heat units of consumed fuel. **Thermion.** A negatively-charged electron or positively charged ion emitted by incandescent body. **Thermionic current.** Flow of electrons within a "valve" from filament to anode. **T. emission.** Discharge of electrons from cathode or valve filament. **T. valve.** Vacuum-bulb containing filament that, when heated, emits electrons that fly to the positively-charged anode, the flow being controlled by additional electrodes. **Thermionic tube.**

**Thermodynamics.** Science of relation between *heat* and *work*. **T., first law of.** All physical and vital phenomena are forms of motion susceptible of transformations into one another, in all of which the quantity of mechanical work remains invariable. Mechanical work changes into heat, and heat changes into mechanical work, but the amount of work

is always eq. to the quantity of heat.

$4.184 \times 10^7$  ergs of work *disappear* for each calorie generated or  $4.184 \times 10^7$  ergs of work *appear* for each calorie expended. *Syn.* principle of energetics, Joule's and Mayer's law.

**T., second law of.** No continuous self-sustaining process can transfer heat from a colder to a hotter body.

This means that energy cannot be transferred without a fall of potential, because energy is a product of *quantity* and *intensity*. The former is represented by the bulk of water in a mill-pond or the amount of heat in a boiler; the latter by the height of the pond above the mill-wheel or the temp. of the water in the boiler. Some have ventured to extend the law from limited molecular systems on earth to the boundless molecular and ultra-atomic systems of the cosmos, and so to postulate a "heat-death" of the universe when all energy is at one level and, consequently, unavailable for doing work, a postulate by no means acceptable to others. *Syn.* Carnot's law. *See* Entropy.

**Thermolysis.** Loss of body-heat. Dissociation by heat.

**Thermometer.** *See* Temperature conversion. **Thermo-nasty.**

Orientation to temp. variations. **Thermophilic.** Heat-loving.

*App.* organisms of hot springs. *Opp.* psychrophilic.

**Thermophyte.** A tropical pl. A heat-loving pl. **Thermo-couple-**

**pile.** Instrument composed of thermo-electric couples for measuring minute temp. differences.

*See* Thomson (S.L.). **Thermoscopic.** *App.* organs for sensing temp. changes. *Ex.* "eyes"

of cephalopods. **Thermo-taxis-**

**taxy-tropism.** (1) Body temp. regulation by centre in *corpus striatum*. (2) Orthotaxy. *See* S.L. (3) Orientation of organisms to temp. changes—*e.g.*,



paramœcium moves *towards* a medium at 26° C. and *from* a medium at 36° C. or at 16° C.

**Thermomorphs.** Beast- or mammal-like permian reptiles. Forerunners of mammals. *Ex. pareiosaur.*

**Thigmotaxis.** Reaction to touch (surface-contact) by curving or clinging as in tendrils, by crawling into crevices (insects), or tubes (worms).

**Thigmotropism.** Stereotaxy. Stereotropism. Stereokinesis. Haptotropism. Thigmotropism. *Syn. thigmotaxis (q.v.).*

**Thio.** Prefix indicating partial replacement of O by S in a ch. compound. **Thiobacteria.** Sulphur bacteria.

**Third eye.** Part of pineal body. Parietal eye, as represented in hatteria, ichthyosaurus, etc. **T. eyelid.** *Phoca semilunaris (q.v.).*

**Thorax.** Chest. Part of trunk, between neck and abdomen, containing heart and lungs. Pro-, Meso-, and Metathorax of insects.

**Thorium, ch. el.** Th. Radioactive metal. *At. no.* 90; *at. wt.* 232.12. *Av. life-period.*  $1.89 \times 10^{10}$  to  $2 \times 10^{10}$  years.

In the following tabulation of the break-up of thorium based on the most recent data of various authorities (*see also* Actinium, Uranium), figures to left of symbols denote *at. no.*, those to right, *at. wt.* *l.p.* indicates *av. life-period.*  $\alpha$ ,  $\beta$ , and  $\gamma$  indicate type of radiations emitted, viz., *alpha-particles* or helium nuclei, *beta-particles* or neg. electrons, and gamma waves or very short, high-frequency electro-magnetic radiations. Note that loss of  $\alpha$  lowers *at. wt.* by 4 and *at. no.* by 2, loss of  $\beta$  raises *at. no.* but does not alter *at. wt.*, loss of  $\gamma$  does not alter either *at. no.* or *at. wt.* (*See also* Atomic Number, Atomic Weight, Electron, Proton.)

Thorium  $_{90}^{232}(\text{Th})^{232}$ , *l.p.*  $1.84 \times 10^{10}$ — $2 \times 10^{10}$  years; emits  $\alpha \longrightarrow$

Mesothorium I  $_{91}^{230}(\text{MsThI})^{230}$ , *l.p.* 6.7 years; emits  $\beta \longrightarrow$

Mesothorium 2  $_{91}^{230}(\text{MsTh2})^{230}$ , *l.p.* 6.13 hrs.; emits  $\beta \longrightarrow$

Radiothorium  $_{92}^{230}(\text{RaTh})^{230}$ , *l.p.* 1.90 years; emits  $\alpha \longrightarrow$

Thorium X  $_{92}^{230}(\text{ThX})^{230}$ , *l.p.* 3.64 days; emits  $\alpha \longrightarrow$

Thoron or thorium emanation  $_{92}^{230}(\text{Tn})^{230}$ , *l.p.* 54.5 secs.; emits  $\alpha \longrightarrow$

Thorium A  $_{92}^{230}(\text{ThA})^{230}$ , *l.p.* 0.14 secs.; emits  $\alpha \longrightarrow$

Thorium B  $_{92}^{230}(\text{ThB})^{230}$ , *l.p.* 10.6 hr.; emits  $\beta, \gamma \longrightarrow$

Thorium C  $_{92}^{230}(\text{ThC})^{230}$ , *l.p.* 10.5 mins.; emits:—

65%  $\beta$ -particles and 35%  $\alpha$ -particles.

The former (65%  $\beta$ )  $\longrightarrow$

Thorium C'  $_{92}^{230}(\text{ThC}')^{230}$ , *l.p.*  $1/10^9$  to  $10^{-11}$  secs.; emits  $\alpha \longrightarrow$

Thorium Q' (lead)  $_{92}^{230}(\text{ThQ}')^{230}$ , *l.p.* ? stable; indefinite.

The latter (35%  $\alpha$ )  $\longrightarrow$

Thorium C''  $_{92}^{230}(\text{ThC}'')^{230}$ , *l.p.* 3.1 mins.; emits  $\beta, \gamma \longrightarrow$

Thorium Q'' or Th.D. or lead  $_{92}^{230}(\text{ThQ}'')^{230}$ , *l.p.* stable; indefinite.

**Thoron.** *See* Thorium.

**Thread-cells.** (1) Nematocysts. Ciliated cells. Stinging cells.

(2) Cells in skin of myxinoids which entangle mucus. **T. worms.** Nematodes. *Filaria.* There are 1600 species (*q.v.*).

**Thremmatology.** Artificial breeding of an. and pl.

**Threshold.** Point at which a phenomenon begins to be produced—e.g., minimum freq. of radiation that produces photo-electric effect.

**Thrombin.** Ferment causing fibrinogen to clot blood. *See* Thrombogen.

**Thrombogen.** Protein in plasma and blood-cells that forms thrombin (*q.v.*).

**Syn. Prothrombin.** **Thrombosis.** Formation of clots with in a blood-vessel. Blocking (by parasites) of pl.-vessels.

**Thrombus.** Clot within a blood-vessel.

**Throttle.** Valve controlling vol. of explosive vapour delivered to cylinders.

**Thulium, ch. el. Tm. Metal.** *At. no.* 69; *at. wt.* 169.4.

**Thunderbolt.** (1) Flash of lightning and accompanying sound. (2) A large meteor that falls to earth with a thunder-like noise.

**Thymus.** Lymphoid endocrine gland in lower part of throat developed from third branchial cleft; it is concerned with growth and blood-formation and disappears towards adolescence. Sweetbread.

**Thyroglossal duct.** Passage conveying secretion of thyroid (*g.v.*) into mouth. In man it is vestigial, closing in second month. **Thyroid gland.** An endocrine (internal secretion) gland of the throat.

Originally a mucus-secreting gland discharging into mouth. It has lost its external secretory function in man and now pours its hormones with growth and energy functions into blood-stream. Decreased function causes cystic goitre, cretinism, idiocy, and myxoedema; increased function causes exophthalmic goitre and extreme nervous irritability. "Adam's apple" is the prominence caused by thyroid cartilages in front of neck. *See* Hypobranchial groove; Thyroglossal; Visceral cleft.

**Thyroxin.** An iodized amine-hormone of thyroid.

**Tibia.** Inner bone of leg. Joint of insect or arachnid leg. Joint above tarsus of a pedipalp.

**Tigellum.** Central embryonic axis; radicle and plumule; hypocotyl.

**Tigroid.** Striped. *Ex.* chromatoplasm.

**Tilodonts.** Eocene insecti-

vors, the ancestors (or closely-related thereto) of rodents.

**Timbal.** Sound-producing membrane of cicada.

**Timbre.** *Quality*, as distinguished from loudness, pitch, etc., of sound. *See* Tone.

**Time.** Observable process of change. It is conceived as being *relative*, not *abs.*—*i.e.*, as consisting in the relations of phenomena. **T. units.** One sec. or 1/86,400 of mean solar day. One min. or 4.90196 × 10<sup>-4</sup> day; 1 mo. or 30.42 days = 2.628 × 10<sup>6</sup> secs.; 1 year (mean solar), 365.2422 mean solar days = 3.15569 × 10<sup>7</sup> mean solar secs. 1 year (sider-eal), 365.256 mean solar days = 3786.144 mean solar hours.

**Tin, ch. el. Sn. Metal.** *At. no.* 50; *at. wt.* 118.700.

**Tine.** Slender, pointed process. *Ex.* antler. **Tinoceras.** **Dinoceras.** **Uintatherium.** A huge, eocene small-brained ungulate.

**Tissue.** An aggregation of cells and intercellular material. Fundamental structure of an. or pl. Four chief kinds: connective, epithelial, muscular, nervous. *See* Vascular. **T., sieve.** **Phloem.**

**Titanium, ch. el. Ti. Metal.** *At. no.* 22; *at. wt.* 47.90.

**Titration.** Standardization. Analysis and determination of concentration of solutions.

**Toise.** Unit of length; 6 ft. or 1/20,522,960 of equator = 1.9490365 metres.

**Toment-ose, -um.** Covered with, or coat of, closely-matted hair.

**Ton.** One long t. = 1.12000 short t. = 1.0160470 metric t. = 1016.0470 kilogramme =

2240 lbs. Av. = 2722.22 lbs.  
Tr. = 10,160,470 grammes =  
15,680,000 grains = 35,840  
ozs. Av. One short t. =  
0.89286 long t. or 2000 lbs. Av.  
or 907.185 kgm.

**Tone.** (1) A sound of *regular* vibrations characterized by *pitch*, or rate of vibration, *loudness*, or sq. of amplitude of vibration, and *timbre* (*q.v.*) or no. of overtones. (2) State of health. **Tonus.** **Ton-ic, -icity.** (1) *Per.* tone, or to tension of body or its parts, to state of health, to responses to stimuli, etc. **Tonus.** (2) Persistent contraction; exhibiting normal reflexes. **Myo-tasis, -tonia.** *Cf.* Clonic. **Tonoplast.** Vacuole wall. **Plastid** containing a vacuole. **Tonotaxy.** Response to solution concentration. **Chemiotropism.**

**Tonsil.** Aggregation of lymphoid tissue on each side of throat developed from second branchial "cleft."

**Tonus.** **Tonicity** (*q.v.*).

**Tooth.** Hard, bony organ of mastication, also of offence and defence, fixed in socket of jaw and adapted for tearing, stabbing, or grinding.

A t. is made up of *pulp*, *dentine*, "*cement*," and *enamel*. In mammals no. rarely exceeds 54, in man 32. Horn of narwhal and tusks of elephant are incisor teeth. The ev. of mammalian dentition (*q.v.*) from a reptilian is shown by the relics in mammals of teeth series before the milk teeth and after the permanent ones. *See* Buno-, Haplo-, Hetero-, Hypselo-, Lopho-, Monophyo-dont; Enamel; Dental; Dentine; Dermal; Bicuspid; Molar; Premolar; Canine; Tusk, etc.

**T., permanent.** One of a secondary (usually) set of teeth *after* milk teeth. **T., temporary.** One of the *milk* or *deciduous*

teeth, a set prior to the permanent.

**Tornaria.** Ciliated larva of balanoglossus and enteropneusts. *See* Amphioxus; Membranellæ.

**Tornote.** Blunt ended.

**Torose.** Cylindrical, with alternate bulgings and constrictions.

**Torpedo.** Self-propelling engine for blowing up enemy ships. Electric ray fish.

**Torque.** That which tends to produce rotation. A moment of forces. Product of tangential force and radius of rotating part. A twist. *See* Stress; Strain.

**Torrid zone.** Earth's surface between parallels 23° 27' N. and S. of equator.

**Torsion.** State of twist. *See* Torque.

**Torso.** The trunk of a body.

**Torula.** Yeasts. **Torulose.** Beaded.

**Torus.** Any firm prominence or margin. **Thalamus.** Receptacle. Part of axis that bears floral leaves. *See* Hypanthium.

**Totem.** An an., pl., or inanimate object regarded as having blood-relationship to a person, family, or tribe.

**Toxæmia.** Toxin poisoning.

**Toxin.** Any poison, more especially an. (*ex.* snake), and pl. (*ex.* bacteria), poison. **Phytoxin.** Sarcotoxin. *See* Antitoxin. **Toxophil.** Having affinity for poisons. *See* Haptophore. **Toxophore.** Toxin mol. *Cf.* Haptophore.

**Trabeculæ.** Cartilaginous bars; ridges; folds; muscle strands; fibrous bundles; membranous partitions. Plates of sterile cells in sporangia.

**Trachea.** (1) Wind pipe. Tube conducting air to, and waste gases from, lungs. (2) One of a system of respiratory tubules in arthropods, insects, etc. (tracheates). (3) Water-conveying vessel of pl. Cf. Tracheid. Tracheal gills. Abdominal respiratory outgrowths of water-larvæ. Tracheal mirror. Tapetum (*g.v.*). Tracheates. Insects and arthropods that breathe by trachea. Tracheids. Long, narrow, supporting, and water-conveying tube-like cells of pl. xylem. Cf. Trachea. Trachelate. Narrowed, like a neck. Trachenchyma. Tracheal tissue. Trachyspermous. Rough-seeded.

**Tractate.** To attract. To move or tend to move towards one another. *Opp.* pellate. **Tractellum.** A *pulling* flagellum at front end of organism. Cf. Pulsellum.

**Trade winds.** Constant winds towards equatorial zone of low pressure. S. of equator, earth's W. → E. rotation causes S.E. trade; N. of equator, earth's W. → E. rotation causes N.E. trade.

**Tragus.** Eminence in front of ear-hole.

**Trajectory.** Curved path of a body—*e.g.*, projectile—through space.

**Trance.** Deep hypnosis. Profound abstraction.

**Transcendental.** *Per.* assumed things and phenomena beyond experience.

**Transformation.** Change of form. Metamorphosis. Evolution. **Transformer.** Apparatus for changing intensity of E.M.F. A *step-up* t. turns a large current at low voltage (low potential) to a small cur-

rent at high voltage (high potential); a *step-down* t. turns high to low potential. **T. efficiency.** The watts (voltage × current) put into the primary is = watts taken out of secondary, and the volts per primary turn = volts per secondary turn. **Transformism.** Metamorphosis. Change. Evolution.

**Transfusion.** Act of transferring a saline solution, or blood from an an. or human being, into another an. or human being.

**Transit.** Passage of a celestial body across meridian, or field of telescope, or across disc of a larger body.

**Translation.** Motion in which all points of a body have at any instant the same vel. and direction. Cf. Rotation.

**Translucent.** *App.* media that *transmit* and *diffuse* light.

**Transmission.** Act of sending or passing on. Ratio of amount of energy leaving a last surface (of a medium) to amount of energy entering first surface. **T. efficiency.** Ratio of power received over a transmission path to the power transmitted.

**Transmutation.** Change of one species or ch. el. into another species or ch. el. Metamorphosis. Evolution. Transformation.

**Transparent.** Pervious to radiation—heat, light, X-rays, etc. Cf. Diathermanous. *Opp.* opaque.

**Transpiration.** Aqueous vapour exhalation through pores, stomata, etc.

**Trapezium.** (1) Plane figure bounded by four non-parallel straight lines. (2) Wrist bone.

**Traumatism.** Injury or its resulting disease. **Traumatonasty.** Curvature-response of pl. towards site of injury. *Cf.* **Traumatotropism.** **Traumatotropism.** Movement of pl. organ—e.g., root—away from site of injury. *Cf.* **Traumatotaxy;** **Traumatonasty.** **Traumatotaxy.** Sensitivity and response to injuries, especially app. nuclei and protoplasts. *Cf.* **Traumatonasty,** -tropism.

**Trematodes.** Flukes. **Turbellarian worms.**

**Tremelloid.** Gelatinous. **Trembling** like jelly.

**Triad.** Trivalent atom, etc. *See* Valency. **Triadelphous.** Having stamens united in three bundles. **Triandrous.** With three stamens. **Trianthous.** Three-flowered. **Triarch.** With three xylem bundles. **Trias. n.** **Triassic. a.** Early mesozoic period, following permian, preceding jurassic. **Tribasic.** With three replaceable H atoms. **Triceps.** Three-headed. *Ex.* muscle of arm and leg. **Triceratops.** Cretaceous dinosaur.

**Trichina, Trichinosis.** Nematode worm and the disease it causes in man or pig. **Trichocarpous.** Hairy-fruited. **Trichocyst.** Sac containing stinging organ. **Trichogen.** A hair-producing cell. **Trichogyne.** Hair-like cell of carpogonium. **Trichoid.** Hair-like. **Trichome.** Hair. Exudate gland-hair. **Trichophore.** Hair-bearer. Chaetiginous sac. Supporting cells of trichogyne. **Trichosis.** Hair distribution.

**Triconodont.** Having teeth with three simple cones (mesozoic marsupials). **Tritubercular.** **Trigonodont.** **Tri-**

**crural.** Three-branched. **Tri-cuspid.** (1) With three cusps, cones, or points. **Tritubercular.** (2) A valve of the heart. **Tridynamous.** With three long and three short stamens. **Trifarious.** Having three faces, whorls, rows, etc.; of three kinds; having three directions. **Trigamous.** Having staminate, pistillate, and hermaphrodite flowers. **Trimonoecious.** **Trigonal.** **Triangular;** ternary; with three parts per whorl. **Trigynous.** Having three pistils. **Trijugate.** With three pairs of leaflets. **Trilobite.** Palaeozoic marine crustacean. **Trilocular.** Three-chambered. *App.* ovary. **Tri-lobous.** Three-rayed, branched, or -ribbed. **Trimerous.** Three-jointed. **Thrice** segmented. **Trimonoecious.** **Trigamous (g.v.).** **Trinitrotoluene.** A high explosive.  $C_7H_5N_3O_6$ . **Trinomial.** Three termed. Name furnishing *genus, species,* and *variety.* **Tricocious.** Having staminate, pistillate, and hermaphrodite flowers on *different* pl. **Trigamous.** *See* Flower. **Triploblastic.** Having three primary germ-layers—epi-, meso-, and hypo-blast. **Triploid.** Having three times the basic (normal gametic) no. of chromosomes. Product of tetraploid + diploid. *See* Polyploid; **Trisomic.** **Triquetrous.** Three-cornered. **Triquinuate.** Ternate with each lobe divided five times. **Trisomic.** Having three chromosomes of one type. **Triploid.** **Tristachyous.** Three-spiked. **Tristichous.** In three rows. **Triternate.** Having each leaflet, of a biternate leaf, ternate. **Tritubercular.** *App.* teeth with

three primary cusps. **Triconodont**, -cuspid. **Triungulus**. Campodeiform six-legged larva. **Trivalent**. *See* Valence. **Trizoid**. *App.* spore holding three sporozoites.

**Troch-al**, -ate, -oid. Capable of rotation. Wheel-like. Ball-and-socket jointed. **Trochelinthes**. Wheel-animalcules. Rotifers. **Trochlea**. Pulley. Groove transmitting a tendon. **Trochoblast**. Part of segmenting ovum. **Trochophore**. An ovoid, free-swimming larva with pre-oral ring of cilia. *Ex.* worms, rotifers, molluscs. *See* Veliger. *Syn.* trochosphere. **Trochosphere**. **Trochophore** (*q.v.*).

**Tropal**. *Per.* tropism. **Tropeic**. Keel-like.

**Trophallaxis**. Reciprocal feeding—*e.g.*, feeding of larvae or social guests by worker-ants or other social insects, and of the two last by the two former. **Trophil**. Mouth-parts. Masticating organs. **Trophism**. Nutrition. **Trophobiont**. A parasite or symbiont that also acts as host. Either of two reciprocal feeders. *See*

**Trophallaxis**. **Trophobiosis**. Symbiosis (*q.v.*) *plus* trophallaxis (*q.v.*). **Trophoblast**.

Specialized epiblast of mammalian egg and embryo which nourishes and attaches them to uterus; its outer layer is the trophoderm. *Syn.* trophosphere. **Trophoderm**. *See*

**Trophoblast**. **Trophochromatin**. Chromatin regulating cell-metabolism. *Cf.* Idiochromatin. **Trophochromidia**. Chromidia concerned in nutrition. *Cf.* Idiochromidia.

**Trophocyte**. A "fat-body" cell. **Trophodisc**. Gamete-

nourishing cells in hydrozoa.

**Trophogenesis**. Development depending on nature of food.

*Cf.* Blastogenesis. **Trophonema**.

Villi that nourish embryo. **Trophonucleus**. Larger

nucleus (in binuclear cells) concerned with nutrition. *Cf.*

Kinetonucleus. **Trophoplasm**.

Active nutritive substance of protoplasm as *cf.* *c.* idio-,

archo-, or kino-plasm. *Syn.* chromatoplasm. **Trophoplast**.

Cell. Plastid. Amylo-, ana-, auto-, chromo-, chloro-plast.

**Trophosome**. Nutritive zooid. **Trophosphere**. **Trophoblast**

(*q.v.*). **Tropho-taxis**, -tropism.

Chemiotaxis in which food is stimulating agent. **Tropho-**

thylax. Food-receptacle in first abdominal segment of ant

larva from which workers feed. **Trophozoite**. Mature sporo-

zoon. **Trophozooid**. Nutri-

tive, sterile zooid. An asex-

ually-produced fixed coral.

**Tropic**. *Per.* the tropics or to tropisms. **Tropics**. Zone

between two circles parallel to equator, one 23° 27' N. of it =

*T. of cancer*; one 23° 27' S. of it = *T. of capricorn*. **Tropism**.

Response by orientation, by rotation, or by translation, to a

stimulus; if towards stimulus source the tropism is "positive,"

if away from it, it is "negative."

*T.* is a response of whole organism; *Cf.* Reflex action. *Syn.* tropy; tropo-

taxis; taxis; irritability. Turning and twisting movements. Includes:

aero-, anemo-, chemo-, chromo-, cyto-, dextro-, diageo-, dial-

helio-, diaphoto-, electro-, exo-, gal-

vano-, gamo-, geo-, hauto-, helio-, histo-, hydro-, hygro-, lao-, neuro-,

parahelio-, parasito-, photo-, plagio-, pneumo-, progeo-, prohydro-, pro-

photo-, rheo-, seleno-, sinistro-, sito-, stereo-, thermo-, thigmo-, tropho-,

vibro-tropism; tropotaxis; tropo-

**Tropopause.** Boundary layer of atmosphere (*q.v.*) around earth, 11 miles above equator, 7 miles above lat. 50°, 4 miles over poles, separating stratosphere above from troposphere below. **Trophophilous.** Thriving under extremes—*e.g.*, heat and cold, dryness and wetness, etc. **Trophophyte.** Trophophilous (*q.v.*) pl.—*e.g.*, one that is xerophytic and hygrophytic. **Troposphere.** Atmospheric layers below tropopause (*q.v.*) and stratosphere (*q.v.*). **Tropotaxis, -y.** **Tropotropism, -y.** **Tropism** (*q.v.*).

**Truncate.** Square-ended; shortened; ending abruptly. **Trunk.** Main stem. The body less the head and limbs. **Proboscis.**

**Tryma.** One-chambered, one-seeded, indehiscent, separable-rinded fruit with two-valved endocarp. *Ex.* walnut.

**Trypanomonad.** Invertebrate host stage of trypanosome.

**Trypanosome.** Parasitic, flagellated protozoan. **Trypanomonad.** Crithidial.

**Trypsin.** (1) Protease enzyme of pl. and an. (2) Secretion of pancreas that turns proteins to peptones and amino-acids.

**Tsetse.** The fly *glossina* which inoculates horses, etc., and man with a parasite causing *nagana* in former and *sleeping-sickness* in latter.

**Tuatara.** Only surviving rhynchocephalian (*q.v.*) now confined to islands off New Zealand. It has a vestigial third eye. *Syn.* hatteria; sphenodon.

**Tube-feet.** (1) Tentacles. (2) Sensory, respiratory, and locomotor appendages of an

echinoderm's water-vascular system.

**Tuber.** Thickened, underground stem or shoot. *Ex.* potato. **Tubercle.** (1) Any small prominence. Nodule. Root-swelling. (2) Tuberculosis. (3) *App.* bacillus of tuberculosis. **Tuberculosis.** *Syn.* tubercle; phthisis. Consumption. Disease caused by tubercle bacillus. **Tubicolous.** Inhabiting tubes. *Ex.* worms, trap-door spiders. **Tubiparous.** *App.* glands that secrete lining of tubes.

**Tumescence.** Turgescence.

**Tumulus.** Mound covering grave. Barrow (*q.v.*).

**Tungsten, ch. el.** W. Metal. *At. no.* 74; *at. wt.* 183.92.

**Tunic.** Covering, containing cellulose, of tunicates. Mantle. Test. Seed-coat. *See* Tunicin. **Tunicates.** Urochordata. *Cl.* of chordates including ascidians and sea-squirts. **Tunicin.** An. cellulose.

**Turacin.** A red, copper-containing pigment in feathers.

**Turbellarians.** A group of ciliated flat-worms including trematodes and cestodes.

**Turbin-al, -ate.** (1) *a.* Spirally-coiled. Scroll-like. Top-like. (2) *n.* Bone of nose. **Turbine.** Rotary engine operated by steam or water under pressure playing on vanes of a rotatable spindle.

**Turgescence, Turgor.** Tension or pressure in cells due to transpiration. Swelling of erectile tissue. **Turgidity.** **Tumescence.** State of normal tension in cells. Distension of cell-walls by intussuscepted fluids. *Opp.* wilting.

**Turion.** Scaly shoot budded off a subterranean stem.

**Turpentine.** Exudations of various conifers. They are all unsaturated hydrocarbons. ( $C_{10}H_{16}$ ).

**Tusk.** Enlarged incisor or canine tooth (*q.v.*).

**Twins.** Two individuals produced at one birth.

**True or identical t.** have developed out of a single fertilized egg-cell, are always of the same sex, are enclosed in same foetal membrane, and are very similar in mental and physical characteristics. Ordinary or "fraternal" t. have come from two fertilized egg-cells, are enclosed in separate membranes, are often very unlike mentally and physically, and may be of different sexes. *See* Polyembryony.

**Tylosis.** Callosity. An intrusive mass of cells such as that which blocks tracheal cavities and so causes sap-wood to become heart-wood. **Tylo-tate, -te.** Knobbed at one end, or at both ends. Dumb-bell shaped.

**Tympanic membrane.** Tympanum. Outer membrane of ear-drum. **Tympanum.** (1) Drum-like chamber of middle

ear, from the outer to the inner membrane of which stretch the three ossicles, *malleus, incus*, and *stapes*. It is developed from first and second gill-clefts. *See* Ear. (2) Membrane of the middle ear or of the auditory organ on leg or abdomen of insects, etc. (3) Distensible air-sac of birds.

**Tyndall effect.** Scattering of a beam of light by minute suspended particles.

**Type of Desor.** Larva of cert. worms. *Cf.* *Pilidium*.

**Typhlosole.** Folded-in portion of dorsal wall of gut in worms. **Typhoid.** Infective disease with ulceration of intestines caused by *bacillus typhosis*. **Typhus.** Eruptive disease transmitted by lice.

**Tyrannosaurus.** Carnivorous cretaceous dinosaur about 47 ft. long.

**Tyrian purple.** Dye prepared by ancients from adrectal gland of shell-fish; now made synthetically.

## U

**Uintatherium.** *Tinoceras* (*q.v.*).

**Ulna.** The inner of the two bones of fore-arm.

**Ulotrichous.** Having woolly or curly hairs.

**Ultragaseous, phy.** *App.* matter when in state of free atoms or of sub-atoms.

**U-microbes.** Hypothetical living entities below the limit of visibility.

**U-microscope.** Microscope in which, by means of a side-beam of concentrated light, particles too minute to be seen in the ordinary way are rendered visible. **U-violet.** *App.* radiations outside those

of the visible spectrum given off by very hot glowing solids and ionized gases. *See* Light; Waves. *Cf.* *Infra-red*.

**Umbel.** Type of racemose inflorescence in which all the flowers are at practically the same level.

An arrangement of flowers springing from a common centre and forming a flattish circular cluster. The "head" of an umbelliferous flower. A simple u. is the cowslip, a compound u., fool's parsley.

**Zoo.** A similar arrangement of polyps. **Umbellate.** Arranged in umbels. **Umbelliferæ.** An Order of pl. bearing umbels.



**Umbelligerous.** Bearing umbels. **Umbellula.** A cluster of flowers or of polyps. A small or secondary umbel.

**Umbilical cord.** The fibrous band of nutrient- and blood-vessels that connects the embryo and foetus with the placenta. **U. vesicle.** Yolk sac (*q.v.*). **Umbilicate.** Having a central depression. **Umbilicus.** (1) The depression in the abdominal wall at site of attachment of umbilical cord. *Syn.* navel. (2) Basal depression of cert. spiral univalve shells. (3) Opening near base of feather. (4) A hilum.

**Umbo.** The apex of the hollow cone of each valve of a bivalve mollusc. The dorsal projection or "beak" which represents the first and oldest part of a shell. A boss on any shield-like structure. **Umbonate.** Provided with a boss or umbo.

**Umbraculiferous.** Bearing an umbrella-like organ. **Umbraculiform.** Umbrella- or mushroom-shaped. **Umbraculum.** Any mushroom-shaped structure.

**Umbrella, zoo.** (1) Contractile disc of jelly-fish. (2) Web-like structure connecting the arms of octopods.

**Unciferous.** Possessing hook-like processes. **Unciform.** **Uncinate.** (1) Hook-shaped. (2) The hamatum, a bone of the wrist. **Uncinus, zoo.** (1) One of the "hooks" on segment of worm. (2) Do. in infusorians. (3) Marginal "tooth" of radula of gasteropods. *Bot.* A hook-like structure in cert. flowers.

**Unconditioned reflexes.** The relatively simple, definite, and inborn responses of an animal

to stimuli emanating directly or indirectly from the external world through constant and unchanging connections in the central nervous system. *Ex.* secretion of saliva on tasting, seeing, or smelling food. The u.r., in contrast to the conditioned r. (*q.v.*), is an essential function of the lower parts of the nervous system and can take place in the absence of the cerebral hemispheres. *Syn.* inherited r.; innater r.; constant r. *See* Reflex.

**Unconformable strata, geo.** Strata not arranged in parallel layers, but so disposed that one set rests on the upturned edges of another set.

**Undose.** Having parallel wavy depressions.

**Ungual.** *Per.* or possessing nails, hooves, or claws. **Unguiculate, bio.** Having claws. *Bot.* *App.* petals with a narrow stalk-like base. **Unguis.** (1) A nail, claw, or hoof. (2) The lachrymal bone. (3) The stalk-like part of cert. petals. (4) A chitinous hook on foot of insects. (5) Distal joint of chelicerae of spiders. (6) A fang. *Syn.* crochet. **Ungulata.** Hoof-bearing mammals. **Unguligrade.** Walking on hooves.

**Unicellular.** *Syn.* monocellular. *App.* organisms that consist of but one cell. **Uniciliate.** Possessing a single cilium, flagellum, or tractellum. **Unicostate.** One-ribbed. *App.* reticulate-veined leaves that possess a single mid-rib. **Unifoliate.** *Syn.* monophyllous. Having one leaf. **Unifoliolate.** Having one leaflet. **Unijugate, bot.** *App.* pinnate leaf with one pair of leaflets. **Unilocu-**

lar. Possessing one div., compartment, or cavity. *Bot.* *App.* an ovary in which carpels in a syncarpous gynæcium enclose a single chamber. *Syn.* monothalamous. Monothecal. Unimucronate. *App.* leaves with a sharp, pointed tip. Uniparous. (1) *Zoo.* Producing one only at a birth. (2) *Bot.* Having a cymose inflorescence with one axis at each branching. Unipolar. Having one pole only. *Zoo.* *App.* nerve-cells with one pole only, consequent on the axon and dendrite of a bipolar cell having fused. Unisepate, *bio.* Having a single partition. Unisetose. Possessing one bristle. Unisexual, *bio.* *App.* a m. or a f. an. or pl. in contrast with a bisexual (hermaphrodite, *q.v.*) individual; also to plants in which pistil and stamens are borne by different flowers. *Ex.* dog's-mercury. *Syn.* diclinous. See Germiparity. Univalent. (1) *Bio.* *App.* a single, unpaired chromosome or to a chromosome that lacks (or fails to unite with) a synaptic mate. (2) *Ch.* *App.* an el. or radicle having a valence (*q.v.*) or combining power of one. Univalve. A single-celled mollusc. *Ex.* snail; periwinkle.

**Uranium, *ch. el.*** U. Radio-active metal. *At. no.* 92; *at. wt.* 238.07.

U breaks up as shown below; the data are taken from works by Lord Rutherford, to a lesser extent from those of other authorities. (See also under Actinium and Thorium.) Figures on left of symbols represent *at. no.*, those on right, *at. wt.* The radiations emitted are  $\alpha$  = alpha-particles or helium nuclei,  $\beta$  = beta-particles or electrons, and  $\gamma$  = gamma (very short electromagnetic) waves.

l.p. = average life-period. Note that the loss of an  $\alpha$ -particle lowers *at. wt.* by 4 and *at. no.* by 2, loss of a  $\beta$ -particle raises *at. no.* by 1, but does not (appreciably) affect *at. wt.*, expulsion of a  $\gamma$ -wave is without (appreciable) effect on either. (See Atomic Number; Atomic Weight; Electron; Proton.)

Uranium I  $_{92}(\text{U.I})^{238}$ , l.p.  $4.56 \times 10^9$  years; emits  $\alpha \rightarrow$

Uranium X.1  $_{92}(\text{UX.1})^{234}$ , l.p. 24.1 days; emits  $\beta, \gamma \rightarrow$

Uranium X.2 (proto-actinium)  $_{91}(\text{UX.2})^{234}$ , l.p. 1.14 min.; emits  $\beta, \gamma \rightarrow$

Uranium II (brevium)  $_{92}(\text{U.II})^{234}$ , l.p.  $2.7 \times 10^4$  years; emits  $\alpha \rightarrow$

Ionium  $_{88}(\text{Io})^{226}$ , l.p. 8.3-10.4 years; emits  $\alpha \rightarrow$

Radium  $_{88}(\text{Ra})^{226}$ , l.p. 1590 years; emits  $\alpha, \gamma \rightarrow$

Radon (radium emanation or niton)  $_{86}(\text{Rn})^{222}$ , l.p. 3.82 days; emits  $\alpha \rightarrow$

Radium A  $_{84}(\text{RAA})^{218}$ , l.p. 3.05 mins.; emits  $\alpha \rightarrow$

Radium B  $_{84}(\text{RAB})^{214}$ , l.p. 26.8 mins.; emits  $\beta, \gamma \rightarrow$

Radium C  $_{82}(\text{RAC})^{214}$ , l.p. 19.7 mins.; emits  $\beta, \gamma$  (99.97%);  $\alpha$  (0.03%).

The former (99.97%  $\beta, \gamma \rightarrow$ )

Radium C'  $_{84}(\text{RAC}')^{214}$ , l.p.  $10^{-6}$  sec.; emits  $\alpha \rightarrow$

Radium D (radium-lead)  $_{82}(\text{RAD})^{210}$ , l.p. 22.0 years; emits  $\beta, \gamma \rightarrow$

Radium E  $_{82}(\text{RAE})^{210}$ , l.p. 5.0 days; emits  $\beta \rightarrow$

Radium F (polonium)  $_{84}(\text{RAF})^{210}$  or  $_{84}(\text{Po})^{210}$ , l.p. 140 days; emits  $\alpha, \gamma \rightarrow$

Radium O' (uranium lead)  $_{92}(\text{RAO}')^{206}$ , l.p. stable and indefinite.

The latter (0.03%  $\alpha \rightarrow$ )

Radium C'' or radium C2  $_{81}(\text{RAC}'')^{210}$ , l.p. 1.32 mins.; emits  $\beta \rightarrow$

Radium O'' (lead)  $_{82}(\text{RAO}'')^{210}$ , l.p. stable and indefinite.

**Urceolate.** Pitcher-shaped. *App.* calyx or corolla of flowers and to shells of protozoa.

**Urea.**  $\text{CO}(\text{NH}_2)_2$ . Long needle-like or rhombic prisms, very soluble in water. A waste product of mammals. The corresponding waste-product in birds is uric acid,  $\text{C}_5\text{H}_4\text{N}_4\text{O}_3$ . Urea can be made artificially by heating ammonium iso-

cyanate,  $\text{CON}_2\text{H}_4$ . *Syn.* carbamide.

**Uredinium.** Mycelium-bearing uredospores (*q.v.*) of uredo.

**Uredo.** Summer stage of "rust" fungi or *basidiomycetes*. *Cf.* *Æcidium*. **Uredospore.** Reddish summer spores borne on sporophores of "rusts" or *basidiomycetes*.

**Ureter.** Duct that conveys urine from kidney to bladder or to cloaca.

**Urethra.** The duct, in m. or f., that conveys urine from bladder to exterior, and in m. semen from the vesiculæ to the exterior.

**Uric acid.** *See* Urea.

**Urine.** In mammals the fluid, and in birds and reptiles, the semi-solid, excretion of the kidneys containing waste-products.

**Urobilin.** A pathological yellow pigment of urine. *Cf.* **Urochrome.** **Urochord.** (1) The skeletal axis of the "tail" of larvacea. (2) One of the urochordata. **Urochordata.**

*Syn.* tunicata. **Ascidians.** Larvacea. The u. are chordata in which a notochord is present in tail end of body only. There are 1,400 species (*q.v.*). **Urochrome.** A normal yellow pigment of urine. *Cf.* **Urobilin.**

**Urodæum.** A recess of the cloaca in chelonians and crocodiles into which genital and urinary ducts open. *Cf.* **Copro-dæum.** **Urodela.** *Syn.* caudata. Tailed amphibians.

*Ex. newt.* **Urogenital canal or sinus.** The passage serving as a common channel for urinary and genital products. **Uron-**

**eme.** A tail-like structure in cert. protozoa. **Uropatagium.** (1) The membrane stretching

between the two thigh-bones in bats. (2) Podical plate of insects. **Uropod.** *Syn.* pleopod. Any abdominal appendage in crustaceans. **Uropygial gland.** Oil-gland of birds. **Uropygium.** The protuberance at posterior end of a bird's body containing the tail vertebra and supporting the tail-feathers. **Urorubin.** A pathological red pigment of urine. **Urosome.** Tail region of fish. Abdominal region of arthropods. **Urostheneic.** Having the tail specialized for propulsion. **Urostyle.** Post. part of spine in anurous amphibians. The hypural bone of fishes.

**Uterus.** *Syn.* womb. An organ in f. mammals in which the embryo and fetus are protected and nourished before birth.

In lower verts. the u. is a simple enlargement of the oviducts and serves the same purpose.

**U. masculinus.** The utricle or *sinus pocularis*.

It is the remnant in the m. of the fused terminal segments of the two Müllerian ducts, and consists of a sac attached to the median dorsal surface of the urogenital canal.

**Utricle, bot.** (1) An air-bladder of aquatic pl. (2) A membranous, indehiscent one-celled fruit. (3) *Zoo.* A membranous sac of aural labyrinth. (4) The *uterus masculinus* (*q.v.*).

**Uva.** A pulpy, indehiscent grape-like fruit with a central placenta.

**Uvea.** Pigmented epithelium covering posterior surface of the iris of the eye.

**Uvula, zoo.** (1) A sensitive, pendulous process of the soft palate. (2) A lobe of the cerebellum.

## V

**Vacuole.** Cavity within a cell containing air, gases, liquids, sap, food, waste-products, etc.

**Val-ence, -ency.** A numerical statement of the ability of an atom to combine, or the way in which an atom can be exchanged with another atom or atoms, expressed in terms of the combining capacity of hydrogen as unity.

Thus H, N, and Cl are normally monovalent, O and S divalent, P and B trivalent, and C and Si tetravalent. Some elements are polyvalent—*e.g.*, nitrogen in laughing gas,  $N_2O$ , is monovalent, in nitric oxide, NO, is divalent, in ammonia,  $NH_3$ , is trivalent, in nitric peroxide,  $NO_2$ , is tetravalent, while in anhydrous nitric acid,  $N_2O_5$ , it is pentavalent. Sulphur in sulphuretted hydrogen,  $H_2S$ , is divalent, in sulphur trioxide,  $SO_3$ , hexavalent, and in sulphur dioxide,  $SO_2$ , tetravalent. Manganese in the oxide  $Mn_2O_7$  is heptavalent, and osmium in the oxide  $OsO_4$  is octovalent. Argon, A, and neon, Ne, have no valency; they are non-valent. Valency, taking the elements argon, hydrogen, oxygen, phosphorus, carbon, nitrogen, sulphur, manganese, and osmium as examples, is expressed thus: A°, H<sup>I</sup>, O<sup>II</sup>, P<sup>III</sup>, C<sup>IV</sup>, N<sup>V</sup>, S<sup>VI</sup>, Mn<sup>VII</sup>, Os<sup>VIII</sup>. Valency has an electronic origin, a univalent atom being one that gains stability by *losing* or by *gaining* one electron.

**Vanadium, ch. el. V. Metal.**  
At. no. 23; at. wt. 50.95.

**Vapour.** The gaseous substance obtained from a body that is liquid at ordinary temp.—*e.g.*, steam (*q.v.*), is water v.

A v. differs from a gas in that it can be reconverted into a liquid by pressure alone, whereas a gas requires p. and lowering of temp. See Cloud; Fog.

**V. density.** The relative wt. of a v. or gas as compared with

some fixed standard gas, such as H. The v.d. of a gas or vapour is half its molecular wt. **V. pressure.** The p. exerted by the saturated vapour of a substance.

**Vaporization, latent heat of.** *Syn.* l.h. of evaporation. The quantity of heat, measured in calories, which 1 gramme of a liquid absorbs in passing from the liquid to the gaseous state without change of temp.; and also which it gives out in passing back from a vapour to a liquid.

If the l.h.v. of water is 607, this means that as much heat is *lost* (*i.e.*, absorbed) in turning one pound of that liquid at 0° C. to the vaporous state at 0° C. as would raise 607 lbs. of water through 1° C. Or, if the l.h.v. of alcohol is 236, this means that in converting 1 lb. of alcohol vapour at 0° C. into liquid alcohol at same temp., as much heat would be *gained* (*i.e.*, given out) as would raise 236 lbs. of water through 1° C.

**Variation.** Divergence from type in cert. characteristics. A change in organisms which makes them *appreciably* different from their parents.

V. may be quantitative or qualitative; continuous—*i.e.*, change by minute increments or decrements—or discontinuous—*i.e.*, change by sudden and wide increments or decrements called mutations—phenotypic—*i.e.*, produced by changes in environment—or genotypic—*i.e.*, produced by recombinations or mutations in the genes.

**Vascular. Per. vessels. V. bundles, bot.** A group of tubes through which ch. solutions (sap) pass from roots to leaves in higher pl., consisting of vascular, tracheal, parenchymatous, and sieve tissues and

vessels arranged as (1) a woody part or xylem and (2) the bast or phloem, a thin strip of cambium sometimes separating the two. **V. cylinder.** The main part of the stem in gymnosperms, lying internal to the endodermis of the cortex and consisting of pericycle, phloem, cambium, xylem, pith. **V. tissue.** That part of gymnosperm stem within the pericycle.

**Vasculum.** Ascidium.

**Vector.** (1) A straight line representing the magnitude and direction of action of a force. (2) *Zoo.* Any disease germ-carrying organism.

**Vegetative cell.** The larger of the two cells into which a pollen grain divides. **V. cone, bot.** The apical point. **V. nucleus.** The nucleus that forms the pollen-tube. **V. pole.** The lower and slower segmenting portion of a telolecithal ovum. That pole of the ovum where food-yolk accumulates. *Syn.* yolk p. *Cf.* Animal p. **V. reproduction.** Asexual reproduction. Bud-formation in animals.

**Veliger.** The second larval stage of cert. molluscs characterized by a ciliated area, or *velum*, borne on the head. It succeeds the *trochosphere* stage (*q.v.*). *See* Larva.

**Velocity.** Rate of change of position—i.e., rate of change of length per sec.

**V.** is *speed (q.v.)* measured in distance per unit of time. The rate of change of *v.* is measured "per sec. per sec." *See* Acceleration. *v.* specifies magnitude and direction; it is speed in a definite direction.

**V., angular.** The no. of units of angle (radians or degrees) swept over by radius vector in

unit time. The rate of change of unit angle per sec. *See* Radian. **V., areal.** Area swept out by radius vector in unit time. **V., linear.** Linear units (cm., ft.) passed through by a body in secs. **V. of escape.** The vel. which, if exceeded by a body on our equator, would cancel the attraction of gravitation and permit of escape from the earth. The *v.e.* for a body on the earth's equator is 6.94, on Jupiter 37.2, and on the sun 382.54 miles per sec.

**Ventrad.** Facing or turned towards the venter or belly. *Opp.* dorsad. **Ventral.** *Per.* the front, under, or abdominal aspect of an an. or to that part of a petal that faces the axis of a flower, or to the under side of a flat thallus. *Syn.* hypaxial.

**Ventricle.** (1) Cavity of heart; (2) of brain (dia- and meta-cele); (3) part of larynx; (4) gizzard of birds; (5) mid-gut or chylific vessel of insects. **Ventricose.** Swelling out unequally.

**Vermes.** Worms.

**Vermiform appendix.** A lymphoid diverticulum of lower blind end of cæcum, a structure rapidly becoming useless and dangerous in man.

**Vernation.** Leaf-disposition within a bud.

**Verson's glands.** Moulting glands of insects.

**Vertebra(e).** (1) Bones of the spine. In man there are 7 in the neck, 12 in the thorax, 5 in the lumbar, 5 in the sacral and 4 in the caudal region. *Syn.* spondyl. *See* Amphio-, Hetero-, Opistho-, and Procoelous *v.* (2) A disc-like ossicle in ophiuroids. **Vertebrate.** An an. with a backbone.

**Vesicle.** (1) Any small cavity. A cyst, sac, bladder, or vacuole. (2) One of three primary cavities in the brain.

**Vestibule.** (1) Any cavity leading into a second one; (2) part of ear; (3) of heart; (4) of nose; (5) of larynx; (6) space between *labia minora* of the *f. pudendum* (*g.v.*); (7) chamber between spiracle and tracheæ in insects; (8) tube leading to mouth in infusoria; (9) space within tentacular ring of polyzoa.

**Vestige.** Any degenerate or imperfectly developed part or organ that was complete and functional in an ancestor. *Syn.* rudiment. **Vestigial organs.** Organs that are rudimentary, imperfectly developed, and disappearing. "Scaffolding left in the body," of which "relics" there are about 100 in man alone—e.g., the third eyelid, the tail, gill-arches, parts of the pituitary organ, floating ribs, the auricular, scalp, long palmar, plantaris, and the tail extensor and flexor muscles, etc.

**Vibraculum.** See Avicularium.

**Vibrissæ.** Stiff hairs around mouth of carnivora connected with "touch-organs." The "whiskers" of the cat.

**Vibrotaxis; Vibrotropism, bio.** Response to vibrations.

**Vicinism.** Tendency to variation connected with proximity of related forms.

**Virescence, bot.** Production of green colour in petals in place of the usual pigment.

**Virus.** Infective agent below the size-limit of visibility.

**Visceral arches.** A series of gristly arches, of which there

are six in man (four of which at one stage of ev. bore gills) in the mouth and throat. **V. clefts.** A series of clefts or furrows between the v. arches (*g.v.*). *Syn.* spiracle.

**Viscosity.** Friction within a liquid due to mutual adherence of its particles.

V. is represented by the resistance which each particle offers as it slides past others and is dependent upon intermolecular attraction. Fluidity is the reciprocal of v.

**Visual purple.** A reddish-purple pigment in the rods of the retina. *Syn.* rhodopsin.

**Vitalism.** Doctrine that living matter is controlled by a guiding "vital force" and that life phenomena are not always due to physico-chemical processes. Really vital phenomena not yet explained.

**Vital processes.** Assimilation, disassimilation, digestion, excretion, growth, irritability, respiration, motility and reproduction.

**Vitamins.** Accessory food factors (catalysts) present in minute quantities in most natural, uncooked, foods.

V. are distinguished as A, B 1, B 2, C, D, and E. A is present in an-oils, eggs, butter, milk, cheese, carrots, and green pl. B and B 2 are in yeast, peas, beans, eggs, potatoes, wheat-germ, lentils, pea-nuts, whole rice, plants, roots, milk, and fresh fruit. C is in lemons, oranges, potatoes, tomatoes, spinach, and milk. *Syn.* ascorbic acid. D is formed by action of ultra-violet light on a fatty substance, ergosterol, in the skin, it is also present in an-foods, especially fish liver, eggs, butter, milk, and cheese. E is present in plant-oils, cereals, milk, and whole wheat.

**Vitelligenous.** Yolk-producing. **Vitellin.** *Syn.* vitellus (*g.v.*). **Vitelline body.** *Syn.*

yolk-nucleus. A cytoplasmic body within the ovum. **V. duct.** The yolk-duct. **V. membrane.** A membrane enclosing the ovum. **Vitello-intestinal duct.** The duct through which food passes from yolk-sac to mid-gut in the embryo. **Vitello-phags.** Amœboid yolk-forming cells. **Vitellus.** Yolk; the food of vert. embryos. A phospho-protein in seeds and yolk. *Syn.* vitellin.

- **Vivification.** The changes by which non-living matter becomes living matter. **Viviparity, -pary, zoo.** Condition of bringing forth young alive. **Zoogony.** *Bot.* Reproduction by shoots or bulbils.

**Volatilization.** Direct vaporization of a solid without its passing through a liquid state.

**Volt.** The unit of E.M.F. or

the force which propels 1 ampere through 1 ohm resistance. *See* S.L. Voltage. Electric p.; E.M.F.

**Volume.** Magnitude. Cubic capacity. The amount of space occupied by a body. *See* Size.

**Volute, bot.** Spirally twisted. **Volutin.** Particles in cytoplasm that appear during formation of chromatin and exhibit a wriggling motion. **Volution.** The spiral turn of a shell.

**Von Baer's law, bio.** The law of recapitulation which teaches that, to a certain extent, each organism "climbs up" its own genealogical tree during embryonic life, that embryos are unlike the adults but resemble the embryos of other animals whether of the same or of different species. *See* Law of Biogenesis.

## W

**Warning coloration.** Conspicuous red or yellow coloration of the epidermis of poisonous or unpalatable an. which repels enemies. **W. mimicry.** Protective imitation of w. colours of distasteful an. by edible an.

**Water.**  $H_2O$ . A faint greenish-blue, transparent liquid which is an essential to all an. and pl. life and is Nature's universal ch. reagent.

**W.** is composed of 11.188 p.c. of H and 88.812 p.c. of O, or 2 vols. of H to 1 vol. of O, or 2 parts by wt. of H to 16 pts. by wt. of O. The max density of w. (= 1.0) is at 3.945° C.; at 0° C. its density = 0.999. At normal p. (760 mm.) w. boils at 100° C. (H boils at -252.5° C., mercury at 350° C., iron, 2450° C., tungsten, 4800° C.). It solidifies (freezes to ice) at 0° C. (H. at -256.5° C., mercury, -38.8° C., iron, 1600° C.). Like

cast iron, w. expands on solidification. The coefficient of linear expansion of ice = 0.000054 (platinum = 0.000035); of abs. expansion for 1° C. (water) = 0.00035 (mercury = 0.00018). The sp. heat of w. = 1, of ice = 0.502, of steam, 0.4. Its heat conductivity is 0.0125 (silver = 1), latent heat of fusion = 80.03 (lead = 5.37). Compressibility = 1/21,800 (mercury 1/263,150, sea-water 1/22,727). Latent heat of melting of w. is 80 calories; l.h. of evaporation is 536 calories. Density of w. vapour (air = 1.0) is 0.6225. Vel. of sound in w. = 4714 f.s. (air = 1095 f.s.) About 0.2 p.c. of earth's vol. is w., enough to cover it, if smooth, to a uniform depth of 2½ miles, the total weight of pure w. being c.  $12 \times 10^{14}$  tons. About 62 p.c. of a man's body, 85 p.c. of his grey matter, 99.0 p.c. of a jelly-fish, is w. A man requires a daily flow of w. through his body = 4.6 p.c. of his weight. Thus a man weighing 143 lbs. normally ingests and excretes 6.6 lbs. or 5.23 pints of w. per day. Ordinary w. really consists of more than one kind;  $H_2O$ , or hydrol, ( $H_2O$ )<sub>2</sub> or dihydrol and

( $H_2O_2$ , or trihydrol. Ordinary ice is trihydrol, but there is another, and much denser ice. As there are now known to be three kinds (isotopic varieties) of hydrogen, viz., (1)  $H^1$ , the ordinary, single-mass H; (2)  $H^2$ , deuterium, double-mass, or heavy H, present 1/5000 part of ordinary  $H^1$ ; and (3)  $H^3$ , triptogen, triple-mass, or heavy-heavy H, present 1/200,000 part of the  $H^2$  type of H, and as, further, there are also known to be existent three kinds of oxygen, viz., (1) ordinary, or  $O^{16}$ ; (2) heavy, or  $O^{17}$ , and (3) heavy-heavy, or  $O^{18}$ , it is practically certain that there are as many as 18 different kinds of water. Heavy water (containing  $H^3$ ) freezes at  $-3.8^\circ C.$ , boils at  $101.42^\circ C.$ , and, while ordinary  $H_2O$  has a max. density at  $4^\circ C.$ , the max. d. of heavy w. is at  $11.6^\circ$ . Heavy water is poisonous to seeds, tadpoles, and flat-worms, but has been swallowed by man without evil effects. While a gallon of common water weighs 100 ozs., the same vol. of heavy water would weigh 175 ozs.

**W.-bears.** Tardigrada. A div. of arthropods, mite-like animalcules in stagnant w. **W.-fleas.** Minute, free-swimming, copepods in stagnant w. **W.-glands.** Structures at apex of leaves regulating w. passage *via* the stomata. **W. of constitution.** W. retained in crystals after they have been raised to  $110^\circ C.$  Cf. W. of crystallization. **W. of crystallization.** W. associated with crystals that is expelled at or below  $100^\circ C.$  Cf. W. of constitution. **W.-testing organ.** An osphradium (*q.v.*). **W. vascular system.** Network of w.-circulating canals in echinoderms sub-serving respiration.

**Watt.** Unit of power. Amperes multiplied by volts.

The w. is  $= 10^7$  (c.g.s.) E.M.U. or E.S.U. It is one joule, or ten million ergs per sec. The horse-power, 33,000 ft.-lbs. per min., is 746 watts. A thousand watts is 1 kilowatt. See Electromagnetic.

**W.-hour.** Power expended in a circuit by 1 w. in 1 hour.

**Wave.** (1) An advancing disturbance in any medium. (2) A moving ridge on *surface* of a liquid.

In water the velocity ( $v$ ) of a w. is its w.-length ( $\lambda$ ) multiplied by its frequency ( $f$ ) near shore—*e.g.*, a sea-w. has a vel.  $= 39.6$  f.s., a w.-l.  $= 300$  ft., and a frequency of 0.132 per sec. (7.92 per min.) ( $v = \lambda \times f$ —*i.e.*,  $39.6 = 300 \times 0.132$ ). In very deep water, however,  $v = \sqrt{2g\lambda}$ . (3) A spherical "disturbance" moving eccentrically through three dimensions of space—*e.g.*, electro-magnetic waves. Waves are classified as *transverse* when the oscillations of particles are at right angles to the direction of advance—*e.g.*, light-waves; as *longitudinal*, when the oscillations are in the line of advance—*e.g.*, sound. **W. length.** This is the distance from crest to crest of two adjacent waves or the distance travelled by radiant energy in the period of one frequency, it is numerically  $=$  the vel.  $\div$  the freq. The following indicate the w.-l. in cms. of various types of radiation. **Wireless** (Hertzian); (long)  $10^6$  to  $10^8$ ; (med)  $10^4$  to  $10^6$ ; (short)  $10^4$  to  $10^5$ ; infra-red (long)  $10^{-2}$  to  $10^{-1}$ ; (med)  $10^{-3}$  to  $10^{-4}$ ; (short)  $10^{-4}$  to  $10^{-5}$ ; **Light** (red)  $7.5 \times 10^{-5}$  to  $6.5 \times 10^{-5}$ ; (orange)  $6.5 \times 10^{-5}$  to  $5.9 \times 10^{-5}$ ; (yellow)  $5.9 \times 10^{-5}$  to  $5.3 \times 10^{-5}$ ; (green)  $5.3 \times 10^{-5}$  to  $4.9 \times 10^{-5}$ ; (blue)  $4.9 \times 10^{-5}$  to  $4.2 \times 10^{-5}$ ; (indigo)  $4.2 \times 10^{-5}$  to  $4.1 \times 10^{-5}$ ; (violet)  $4.1 \times 10^{-5}$  to  $4 \times 10^{-5}$ . **Ultra-violet** (long)  $4 \times 10^{-5}$  to  $1.8 \times 10^{-5}$ ; (short, Schumann-Lyman)  $1.8 \times 10^{-5}$  to  $10^{-6}$ ; X-ray (long, soft)  $10^{-6}$  to  $2 \times 10^{-7}$ ; (med)  $2 \times 10^{-7}$  to  $10^{-8}$ ; (short, hard)  $10^{-8}$  to  $10^{-9}$ ; **gamma**,  $10^{-9}$  to  $5 \times 10^{-10}$ ; **ultra-gamma** (? cosmic)  $5 \times 10^{-10}$  to (?)  $10^{-12}$ . See Gamma; Light; Coloration; Radiation; Photon.

**Weber.** Unit of magnetic flux (pole strength). It  $= 10^8$  maxwells. **W.'s apparatus.** A chain of four ossicles connecting auditory organ of fishes with air-bladder.

**Weight.** The word really has two meanings: (1) a *quantity*,



as a pound of sugar; (2) an energy of gravity-position, as when a pound of sugar presses down a spring.

In this sense it is the force with which all the particles of the body are attracted by all the particles of the earth and, accordingly, it is a force which varies with the distance from the centre of the earth—i.e., with elevation and latitude. *W.* is *mass*  $\times$  *acceleration* due to gravity (*g.*) at the particular point and is therefore proportional to mass. At the poles attraction on a body due to *g.* is 1/576 greater than it is at equator. In consequence of earth's rotation the magnitude of *g.* at equator is less by 1/289 of what it is at the poles; the net result is that at the equator the attraction of *g.* is less by 1/192 than the attraction of *g.* at the poles. A man weighing 200 lbs. (on a *spring* balance) at the equator would weigh about 201 lbs. at the N. pole, about 33 lbs. 5 ozs. on the moon, and about 5400 lbs. (2.4 tons) on the sun.

*W.*, atomic. The relative *w.* of an atom referred to oxygen = 16.0 (or to hydrogen = 1.0078). It corresponds to *atomic mass* except for elements that are mixtures of isotopes. See Atom; Atomic Weight; Proton. *W.*, equivalent. *At. wt.*  $\div$  valence.

Weismannism, *bio.* *App.* the continuity of the germ-plasm and the non-transmissibility of *acquired* characters.

Whalebone. A horny product of the epithelium of jaws of baleen whales.

Wheel animalcules. Rotifers.

White blood corpuscles. Leucocytes. Amoeboid, nucleated blood-cells.

Whorl. *Syn.* verticil. One twist of a pl.-organ, about axis of growth, or of a univalve shell about its axis. A circle of flowers or leaves arising from one point.

Wind-pipe. The trachea.

Wing. An organ of flight or of dissemination. The feathered fore-limb of bird. Membranous patagium of pterodactyl and bat. Membranous body-wall expansion of insect. Lateral expansion of seed or of petal. See Elytra; Tegula. *W.*, bastard. *Syn.* alula. Process in bird's *w.* representing the thumb. *W.* coverts. *Syn.* tectrices (*q.v.*).

Winter eggs. Eggs of rotifers and other aquatic organisms, specially thickened and much-yolked to delay hatching until winter has passed. *Syn.* teleutogonidia; teliospores; resting eggs. See Statoblast. Cf. Summer eggs.

Wire-worm. Tough-coated larva of cert. beetles. A millipede.

Wireless. See Wave.

Wisdom teeth. The four post. molar teeth in man that erupt later than the others.

Witches' milk. Milk abnormally produced by m. and f. infants or by full-grown m.

Wolffian body. The embryonic mesonephros (*q.v.*). *W.* duct. Duct conveying urine (and sperms) to cloacal aperture. *W.* ridges. Ridges on embryo from which the limb-buds arise.

Womb. The uterus (*q.v.*).

Wood. The hard substance of a tree stem. The xylem (*q.v.*). See Lignin. Cellulose. Lignocellulose. *W.*-lice. Isopod crustaceans.

Work. Transference of energy (*q.v.*) involving motion of the point of application of a force.

*W.* is performed whenever there is movement against resistance or when-

ever a body is given acceleration (*q.v.*). It is measured by the product of the force and the displacement of its point of application in the line of action. In rotating bodies *w.* done is the product of the moment and the angular displacement. Units of *w.* are the ft.-lb., the erg, and the joule (*q.v.*).

**Worker.** A neuter (sterile f.) social insect. *Syn.* ergate.

**Worms.** A "heterogeneous mob" of invertebrate an.

with affinities to coelenterates, echinoids, arthropods, molluscs, and vert. They are the first (lowest) an. in which ecto-, endo-, and meso-derm are distinctly represented. They include earth-, tape-, round-, flat-, and thread-worms, turbellarians, trematodes, rotifers, polychaets, leeches, and many others. *See* Species.

## X

**X chromosomes.** Sex chromosomes (*q.v.*). **X-rays.** Radiant energy of w.-l. 0.5 to 1000 A.U. and freq.  $6 \times 10^{18}$  to  $3 \times 10^{15}$ . Source, bombardment of matter by electrons. *See* Waves; Light; Radiation.

**Xanthocarous.** Having yellow fruits.

**Xanthochroism.** Abnormal yellow coloration—*e.g.*, in feathers. *See* Pigment.

**Xanthophyll.** Yellow pigment of plants. *Syn.* carotin. *Phylloxanthin.*

**Xenogamy, bot.** Cross-fertilization (*q.v.*).

**Xenon, ch. el.** Xe. Inert gas. *At. no.* 54; *at. wt.* 131.3.

**Xero-phil, -phyte.** Drought-pl. A pl. which can limit transpiration and so can grow in deserts.

**Xylem.** Woody part of a vascular bundle lying between pith and cambium.

**Xylocarp.** Woody fruit; **Xylochrome.** Bark pigment. **Xylo-phage, -phil, -tome.** A wood-eater; wood-borer; an organism living in, or breaking-up, woody tissue—*e.g.*, various fungi causing dry-rot; the death-watch beetle (anobium), etc.

## Y

**Y chromosome.** *See* Sex Chromosomes.

**Year.** (1) *Anomalistic y.* 365 days, 6 hrs., 13 min., 53.1 sec. Time taken by Earth to pass from perihelion back to perihelion. (2) *Equinoctial y.* *Astronomical, Natural, Tropical, Solary.* 365 days, 5 hrs., 48 min., 45.51 sec. Time taken by Sun to pass from Vernal Equinox to Vernal Equinox. (3) *Sidereal y.* 365 days, 6 hrs., 9 min., 9.54 secs. Time of

Earth's orbital revolution—*i.e.*, time taken by Sun in completing a revolution from some fixed point (star) in its *apparent* orbit back to same point.

**Yeast.** Cells of cert. fungi. *Saccharomyces.* *Syn.* barm.

**Yellow-cells.** *Syn.* *Zooxanthellae.* (1) Cells, probably excretory, surrounding gut of cert. worms. (2) Symbiotic algæ (*zoochlorellae*). **Y-spot.** *Macula lutea* (*q.v.*).

**Yolk.** *Syn. vitellus; deutoplasm; ooplasm.* Inert, non-formative, nutrient material in egg-cell. Two kinds, white and yellow. On top of both is a minute area of protoplasm "formative material" (*q.v.*) that initiates the embryo. Around both is the albumen or "white of egg." **Y.-cells.** *Syn. vitellophags.* **Y.-duct.** Vitelline duct. **Y.-entoderm.** *Syn. lecithophore; paraderm.* **Y.-epithelium.** Epithelium surrounding y.-sac. **Y.-gland.** (1) A gland that furnishes ova with nutritive material. (2) An embryonic structure consisting of the fertile portion of the ovum and a sterile portion which nourishes the former. **Y.-nucleus.** The vitelline body. **Y.-plates.** Parallel laminae into which deutoplasm sometimes splits. **Y.-plug.** Mass of y.-cells closing the blastopore in

cert. amphibia. **Y.-pole.** Vegetative pole. **Y.-pyramids.** Cert. cells in segmenting egg. **Y.-sac.** Extension of primitive gut that encloses the y.

It is one of two cavities into which archenteron of embryo divides, the other being the enteron. The y-sac remains outside the embryo and becomes filled with y. which passes via the vitelline duct into the gut of the embryo. The enteron comes to lie inside the embryo and divides into the allantois, the fore-, and the hind-gut.

**Y.-spherules.** Pseudo-cells; particles inside ovum consisting of remains of adjacent cells or inter-cellular material which the ovum has ingested. **Y.-stalk.** A strand of fibres and ducts connecting y.-sac and embryo.

**Ytterbium, ch. el.** Yb. Metal. *At. no. 70; at. wt. 173.04.*

**Yttrium, ch. el.** Y. Metal. *At. no. 39; at. wt. 88.920.*

## Z

**Zeugopodium.** Fore-arm. Shank.

**Zinc, ch. el.** Zn. Metal. *At. no. 30; at. wt. 65.380.*

**Zirconium, ch. el.** Zr. Metal. *At. no. 40; at. wt. 91.220.*

**Zoæa.** *Syn. zoea; zoea.* Crustacean larva. **Zoanthella.** A type of larva with transverse band of cilia. *Cf. Zoocanthella.* **Zoanthina.** Type of larva with longitudinal band of cilia. **Zoarium.** *Syn. polypary.* The collection of "individuals" or polypides and their zoecia (*q.v.*) of a polyzoan colony. **Zodiophilous.** *Syn. zoophilous (q.v.).* **Zoea.** *Syn. zoæa (q.v.).* **Zoecia.** *Zoecia (q.v.).* **Zoecial.** *Zoecial (q.v.).* **Zoecium.** *Zoecium (q.v.).* **Zoetic.** *Syn.*

*zoic. Per. an. or to an. life.* **Zoid.** *Zooid (q.v.).*

**Zoidiogam-ic, -y.** The fertilization of pl. by free-swimming spermatozooids. **Zoidiophore.** *Syn. sporoblast.* Spore-mother-cell. Segmented oocyte of *hæmosporida*.

**Zona pellucida.** *Syn. ovolemma.* A membrane surrounding mammalian ovum. **Z. radiata.** The modified outer part of z. pellucida (*q.v.*); it probably represents the vitelline membrane (*q.v.*) of lower an.

**Zono-ciliate.** Surrounded by belt of cilia. **Z.-limnetic.** *Per. plankton, nekton, or to surface waters.* **Z.-placental.** Having a zonary placenta.

**Zoo-anthella.** Symbiotic intracellular cryptomonads of protozoa. *Cf.* Zoanthella. **Z.-biotic.** Living parasitically on an. **Z.-blast.** An. cell. **Z.-caulon.** *Syn.* z.-dendrium (*q.v.*). **Z.-chlorellæ.** Green cells. Symbiotic alga. **Z.-cœnocyte.** Ciliated cœnocyte of alga. **Z.-cyst.** A sporocyst. **Z.-cytium.** *Syn.* zoothecium. Gelatinous matrix embedding massed infusoria. **Z.-dendrium.** *Syn.* z.-caulon. Branched stalk of colonial infusoria. **Z.-dynamics.** An. physiology. **Z.-ea.** Zoœa (*q.v.*). **Z.-ecia.** *Syn.* zoœcia. Sing. Zoœcium. *Per.* chambers, within a protozoan colony, each of which is the dried body-wall of one individual, and houses a nutritive zooid (*q.v.*). **Z.-ecial.** *Syn.* zoœcial. *Per.* z.-œcia. **Z.-ecium.** *See* Zoœcia. **Z.-erythrin, Z.-fulvin.** Red and yellow pigment respectively in feathers. **Z.-gamete.** *Syn.* plasmogamete. An. gamete. Sometimes *app.* to motile pl. gamete. **Z.-gamy.** Sexual reproduction in animals. **Z.-genesis.** Origin and evolution of animals. **Z.-glœa.** Mucilaginous matrix embedding bacteria. **Z.-gonidan-gium.** Asexual reproductive organ in alga; it contains the *Z.-gonidium.* **Z.-gonidium.** *Syn.* megaspore. The ciliated algal spore within a z.-gonidan-gium (*q.v.*) which grows into a new individual. **Z.-gonous.** Viviparous. **Z.-gony.** Viviparity. **Z.-id.** *Syn.* zoid. (1) Living being somewhat resembling, yet somewhat differing from, a free-living entity. (2) A motile cell. (3) A spermatozoon. (4) A relatively

independent organism that has arisen by indirect sexual means (fission, strobilization, proliferation, etc.) and which is therefore a *quasi-individual*. Examples of zooids are corals and hydroid medusæ. (5) Any individual member of an. colony. (6) A sporozoite resulting from div. of sporoblast. (7) The post., genital (non-sexual) region of cert. worms. *Syn.* blastostyle; gonophore; nectocalyx.

According to their function zooids are termed, auto-, blasto-, cyatho-, dactylo-, gastro-, gono-, oo-, siphono-, tentaculo-, tetra-zooids, etc.

**Z.-lith.** (1) Fossil an. (2) Chalky concretion functioning within an an. **Z.-logy.** Science of animals. **Z.-melanin.** Black pigment (*q.v.*) in feathers. **Z.-n.** An individual an. **Z.-nerythrin.** Red pigment (*q.v.*) of feathers. **Z.-nite.** Body-segment. **Z.-nomy.** Laws of an. life. **Z.-philous.** *Syn.* zodiophilous. An.-loving. *App.* pl. adapted for pollination by animals. **Z.-phyte.** An.-pl. (1) An an. with pl.-like habits. (2) A fixed asexual hydroid polyzoon. **Z.-plankton.** Surface-water fauna. *See* Plankton. **Z.-plasm.** An. protoplasm—i.e., protoplasm dependent on products of other living things for nutritive matter. *Cf.* Phytoplasm. **Z.-sperm.** *Syn.* zoospore (*q.v.*). **Z.-sporangium.** Sporangium containing z.-spore. **Z.-spore.** *Syn.* swarm-cell; swarm-spore. (1) Asexual, ciliated, reproductive spore. (2) A motile, amœboid, or active-swimming spore. (3) Motile protoplast (*q.v.*). **Z.-thecium.** *Syn.* zoocytium (*q.v.*).

**Z.-thome.** A united group of animals. *Ex.* coral. **Z.-tomy.** An. dissection. **Z.-toxin.** The poison of snakes, wasps, and other an. **Z.-xanthellæ.** Yellow cells. Symbiotic unicellular algæ. **Z.-xanthin.** Yellow pigment (*q.v.*) in feathers.

**Zygo-branchiate.** Having symmetrically placed gills. **Z.-dactylous.** Having two toes pointed forwards and two backwards. **Z.-doutous.** *App.* teeth with paired tubercles. **Z.-morphic.** *App.* a bilaterally symmetrical flower (*q.v.*). *Syn.* z.-morphous; z.-pleural. **Z.-morphous.** *Syn.* z.-morphic (*q.v.*). **Z.-nema.** Amphitene stage in meiosis. **Z.-phore.** *Syn.* z.-sporophore. Conjugating hypha of fungus. **Z.-phyte.** Pl. with two similar reproductive cells which unite in fertilization. **Z.-pleural.** Zygomorphic (*q.v.*). **Z.-sis.** Cell conjugation. **Z.-some.** Mixochromosome (*q.v.*). **Z.-sperm.** **Z.-spore** (*q.v.*). **Z.-sporangium.** Sporangium in which z.-spores are formed. **Z.-spore.** *Syn.* zygote (*q.v.*). **Z.-sporophore.** *Syn.* z.-phore (*q.v.*). **Z.-taxis.** The reciprocal "attraction" between m. and f. gametes.

**Z.-te.** *Syn.* z.-sperm, -spore. (1) Fertilized egg-cell—*i.e.*, cell formed by union of m. and f. gametes and which gives rise to a new individual. *Syn.* cytula; oospore; fertilized egg. (2) Resting spore resulting from fusion of gametes. **Z.-tene.** Stage when spireme threads unite in pairs in meiosis. **Z.-tic.** (1) *Per.* zygote. (2) *Per.* mutation after fertilization. **Z.-toblast.** Sporozoite or brood-cell produced by segmentation of zygotomere. **Z.-tomere.** (1) Cell resulting from segmentation of zygote. (2) Brood-cell of oosperm. **Z.-tonucleus.** Nucleus formed by fission of two gametonuclei.

**Zymase.** (1) Digestive ferment in animals and plants. (2) An enzyme in bacteria and yeast-cells.

Zymase converts glucose and other carbohydrates into (1) water and carbon dioxide  $\text{CO}_2$ ; (2) into alcohol and  $\text{CO}_2$  (if oxygen deficient) and (3) into lactic acid.

**Zymogen.** *Syn.* pro-ferment. The inactive precursor of a ferment—*e.g.*, pepsinogen is the zymogen of pepsin.

## SUPPLEMENT

**Alpha Particle.** *Symb.*  $\alpha$  or  $\text{He}^{4++}$ .  $\alpha$  is the nucleus of the helium at. or doubly-ionized He. Consists of 2 protons and 2 neutrons. Present in nucleus of at., together with protons and neutrons, though it is not certain whether it exists within the nucleus as  $\text{He}^{4++}$  or as  $n^1 + n^1 + \text{H}^{1+} + \text{H}^{1+}$ ; in any case, the nuclear units are very close-packed—about  $3 \times 10^{-13}$  cm. ( $1.17 \times 10^{-12}$  in.) apart. An  $\alpha$  does not remain as such for long, as it quickly captures 2 electrons and becomes a He atom. The mass of an  $\alpha$  on physical scale is 4.003; it is 7400 times more massive than electron, its actual mass being  $6.69 \times 10^{-24}$  g. It has a radius of  $5 \times 10^{-13}$  cm. ( $1.95 \times 10^{-12}$  in.). The chg. on an  $\alpha$  is  $9.54 \times 10^{-10}$  E.S.U. or twice the chg. on a proton; this chg. is + and  $\therefore$  an  $\alpha$  is deflected by a magnet in same direction as the proton, but in opposite direction to the electron. Its av. vel. is  $1.5 \times 10^8$  cm./sec. (9321 mil. sec.);  $\alpha$  radium its vel. is  $1.6 \times 10^8$  cm./sec. (9942 mil. sec.);  $\alpha$  thorium, vel. is  $2.06 \times 10^8$  cm./sec. (12,800 mil. sec.); with 8 million elect.-volts behind it a vel. exceeding  $1.4 \times 10^9$  cm. sec. (86,096 mil. sec.). The range of an  $\alpha$  in air is 2.5 to 11.0 cm. (0.97 to 4.3 in.); in aluminium 0.01 cm. (0.0039 in.); an  $\alpha$  will pass through 200,000 air-molecules, ionizing them as it does so by knocking out electrons. One gram of radium emits  $1.38 \times 10^{11}$   $\alpha$ -particles per sec. from its nucleus; these  $\alpha$  in their turn, can disintegrate nuclei of atoms below at. wt. of 20 0, e.g.,  $\text{He}^4$  ( $\alpha$ ) +  $\text{N}^{14}$  (nitrogen) produces  $\text{H}^1$  (hydrogen) +  $\text{O}^{17}$  (oxygen isotope). Conversely,  $\alpha$  particles are produced by bombarding boron with neutrons or magnesium with heavy hydrogen, thus:

$\text{B}^{10}$  (boron) +  $n^1$  (neutron) =  $\text{Li}^7$  (lithium) +  $\text{He}^4$  (alpha).  $\text{Mg}^{24}$  (magnesium) +  $\text{H}^2$  (heavy hydrogen) =  $\text{Na}^{24}$  (sodium) +  $\text{He}^4$  (alpha).

**Anode rays.** Stream of  $\alpha$  particles. In an electrified vacuum tube they move in a contrary direction to that of the kathode rays (q.v.).

According to the nature of the residual gas in the tube they are protons, ions, or  $\alpha$ -particles, all carrying a + charge and deflected by a magnet in the opposite direction to the kathode-ray deflection. *Syn.* Positive-, or Canal-, rays.

**Anodoluminescence.** Variety of phosphorescence (q.v.) in which the light-emitting substance has been previously activated by anode rays (q.v.). *Cf.* Cathodo-l., luminescence.

**Antares.** Giant red star. *Diam.*  $6.276 \times 10^{13}$  cm. ( $3.899 \times 10^8$  mi.). *Surface*  $1.234 \times 10^{23}$  sq. cm.  $4.751 \times 10^{17}$  sq. mi. *Vol.*  $1.218 \times 10^{41}$  c.c.  $2.93 \times 10^{33}$  cu. mi. *Mass*  $9.116 \times 10^{34}$  gram,  $8.973 \times 10^{33}$  ton (l.);  $2.009 \times 10^{33}$  lb. av. *Density*  $7.507 \times 10^{-7}$  gram per c.c.;  $1.096 \times 10^7$  oz. av. per cu. mi.;  $4.365 \times 10^{-7}$  oz. per cu. in.

**Atmosphere.** Wt.  $5.2 \times 10^{21}$  gram;  $5.107 \times 10^{11}$  tons (l.);  $1.144 \times 10^{15}$  lb. av. *Pressure*  $1.0332 \times 10^5$  g. per sq. cm.;  $14.696$  lb. av. per sq. in.;  $1.0332 \times 10^4$  kg. per sq. met.;  $1.013249 \times 10^4$  dyne per sq. cm. (at  $45^\circ$ ;  $1.013199 \times 10^4$  dyne per sq. cm.);  $2.1162 \times 10^4$  lb. per sq. ft.

**Auger effect.** Ejection by a single short-w.-l. photon (e.g., X-ray) of two electrons from different orbits (energy-levels) of atom.

**Balmer formula.** Formula providing w.-l. of the lines in the H spectrum.

$$\lambda = K \frac{m^2}{m^2 - 4}, \text{ where } \lambda = \text{w.-l. (Angstrom); } m = \text{any whole number above 2; } K = \text{a constant (the limit number of the series)} = 3646.13. \text{ Suppose } m = 3. \text{ Then}$$

w.-l. is  $\frac{3646.13 \times 3^2}{3^2 - 4} = 6563.03 \text{ \AA.}$

**Balmer series.** Some 30 lines in visible, and near ultra-violet, region of H spectrum. They represent frequencies which increase in the ratio:

$$\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \left(\frac{1}{2^2} - \frac{1}{4^2}\right) \left(\frac{1}{2^2} - \frac{1}{5^2}\right) \dots \left(\frac{1}{2^2} - \frac{1}{32^2}\right).$$

The lines ( $H_\alpha$ ,  $H_\beta$ ,  $H_\gamma$ ) are caused by electrons falling into the second orbit (level) from any higher orbit (level), and the series is expressed generally by the formula  $\nu = R \left( \frac{1}{2^2} - \frac{1}{n^2} \right)$ , where  $\nu$  = frequency,  $n = a$  whole number, 3, 4, 5, 6 . . . , and  $R$  = Rydberg's Constant ( $q.v.$ ).

**Bioluminescence.** Not a vital phenomenon but a variety of chemiluminescence ( $q.v.$ ), taking place in luminous organisms such as bacteria, fireflies, glow-worms, beetles, crustaceans, fishes, etc. *Cf.* Tribo-l. The light-production is associated with yellow granules of *photophycin* ( $q.v.$ ); in the process two substances, *luciferase* and *luciferin* ( $q.v.$ ), take part. The former is present in the body-fluids, and is probably an enzyme or oxidative catalyst; it activates the luciferin inside the cells of the luminous organ. Injected luciferase will act on the luciferin of a nearly-related, but fails to act on that of a distantly-related, animal. The luminescence of some fishes is caused by colonies of symbiotic luminous bacteria imprisoned within the photogenic organ. *Syn.* Organoluminescence. *See* Luminescence.

**Boltzmann constant.** A gas constant expressed per molecule (*i.e.*  $\div$  Avogadro's constant,  $q.v.$ ). B.c. is the ratio of the mean total energy of the molecule to its abs temp.  $K = 1.3708 \times 10^{-16}$  erg per deg. C. *See* Equipartition of energy.

**Candoluminescence.** The emission by cert. incandescent bodies (such as magnesium and zinc oxide) of light of shorter w.-l. than the laws of radiation would lead one to expect. Possibly a form of fluorescence ( $q.v.$ ). *See* Luminescence.

**Cathodoluminescence.** Variety of phosphorescence ( $q.v.$ ) of a body previously irradiated by kathode rays. *See* Anodo-l.; luminescence.

**Chemical equivalent.** Wt. of an element that unites with or replaces 1 gm. H. It is At. wt.  $\div$  valence of at.

**Chemiluminescence.** *Syn.* Phospho-l. ( $q.v.$ ). "Cold" light emitted by cert. substances such as P, freshly-cut Na, and K. Also denotes the light given off during low-temp. oxidations. Ozone bubbled through pyrogallol acid produces brilliant light-flashes. Luminol ( $C_8H_8N_2O_2$ ), even in 1 in  $10^6$  parts, gives out blue light, and when treated with pot.

ferriocyanide and H peroxide glows like red-hot coals, while drops of the liquid break up into vivid "sparks." Oxidation of quaternary salts of dimethylkriacidylum (lucignine) by hydrogen peroxide in the presence of osmium peroxide causes a bright green light even in dilutions of 1 in  $10^{10}$ . *See* Luminescence; bio-l.; oxy-l.

**Compton effect.** (1) The expulsion of electrons from matter by incident homogeneous short X- and gamma-rays; (2) the "scattering" by these electrons of the rays, and (3) the lengthening of their w.-l. and decrease of their energy and frequency. In the process a photon (the quantum of the ray) collides with an electron and knocks it out of the atom, the photon itself deviating with the same velocity but with less energy and frequency and longer w.-l. If reflected straight back, the photon's w.-l. is increased  $4.8 \times 10^{-10}$  cm. ( $1.87 \times 10^{-10}$  in.). As with the photoelectric effect ( $q.v.$ ), the phenomenon is consistent with the corpuscular, *i.e.*, particulate, nature of light and other radiations; it is these radiation corpuscles or particles that constitute "photons" or "quanta." *See* Raman effect.

**Cosmos (of verifiable limits).** *Diam.*  $9.656 \times 10^{27}$  cm.;  $6 \times 10^{22}$  mi.

*Circ.*  $3.033 \times 10^{28}$  cm.;  $1.885 \times 10^{23}$  mi.

*Surf. area*  $2.93 \times 10^{44}$  sq. cm.;  $1.13 \times 10^{46}$  sq. mi.

*Vol.*  $4.507 \times 10^{83}$  c.c.;  $1.081 \times 10^{68}$  cu. mi.

*Density* (matter and energy)  $4.5045 \times 10^{-29}$  g. per c.c.;  $6.62 \times 10^{-14}$  oz. av. per cu. mi.;  $2.6026 \times 10^{-29}$  oz. av. per cu. in.

**Crystal grating.** *See* Diffraction grating.

**Crystalloluminescence.** "Cold" light emitted during crystallization due to friction of the forming crystals. During the rapid formation of ice-crystals this light may be given out. *See* Luminescence; tribo-l.; lyo-l.

**Cyclotron.** Apparatus for conferring high speed to electrons, ions, and other particles. A powerful magnetic field compels the particles to move in a spiral path and to receive periodic accelerations from an alternating high-frequency potential supplied by two half-hollow cylinders in the magnetic field. *Syn.* Magnetic resonance accelerator.

**De Broglie formula.** Formula connecting an electron's w.-l. with its momentum and acceleration. If  $\lambda =$  w.-l.;  $h =$  Planck's constant (q.v.);  $m =$  momentum;  $V =$  volts;  $U =$  potential drop (in volts) to give electron its acceleration. Then:

$$\lambda = h mv = \sqrt{\frac{150V}{U}} \text{ Angstroms} = \sqrt{\frac{150V}{U}} \times \frac{1}{10^8} \text{ cm.}$$

**De Broglie frequency.** The frequency ( $\nu$ ) connected with the energy ( $E$ ) of an electron. It is given by the formula  $\nu = \frac{E}{h}$ , where  $h$  is Planck's constant (q.v.). From this it follows that  $h = \frac{E}{\nu}$ , and  $E = h\nu$ .

**De Broglie wave.** A "wave-group" assumed by de Broglie to be associated with protons and electrons.

**Degradation of energy.** The conversion of available energy into an unavailable form such as heat. Apparently limited to finite systems, for there is abundant evidence in the known universe of compensating factors constantly re-establishing degraded, to available, energy.

**Degradation of radiation.** The lowering of frequency and quantum-energy and the lengthening of w.-l. of any radiation. See Compton effect.

**Diffraction grating.** A polished surface upon which minute parallel striae, grooves, or slits, 20,000 to a cm. or 50,761 per in., are ruled or cut; these play the rôle of dispersing the reflected light or other wave-radiations. In the crystal-grating the natural close succession of parallel planes of atoms effects the light-dispersal.

**Earth. Rad. Eq.** 6378-383 kil.; 3963-34 mi.

**Rad. poles** 6356-912 kil.; 3949-99 mi.

**Circ. Eq.** 40,056-35 kil.; 24,969-04 mi.

**Surf. area** 5-05  $\times 10^8$  sq. kil.; 1-969  $\times 10^8$  sq. mi.; 5-05  $\times 10^{18}$  sq. cm.; 5-195  $\times 10^{15}$  sq. ft.

**Vol.** 1-03  $\times 10^{13}$  cu. kil.; 1-03  $\times 10^{27}$  c.c.; 2-493  $\times 10^{21}$  cu. mi.; 3-672  $\times 10^{23}$  cu. ft.

**Mass** 6-701  $\times 10^{24}$  kg.; 6-701  $\times 10^{27}$  g.; 6-596  $\times 10^{21}$  ton (l.); 1-481  $\times 10^{25}$  lb. av.

**Density (mean)** 5-522  $\times 10^{15}$  g. per cu. kil.; 5-522 g. per c.c.; 8-231  $\times$

10<sup>14</sup> oz. av. per cu. mi.; 5-5152  $\times 10^8$  oz. av. per cu. ft.; 344-7 lb. per cu. ft.; 3-195 oz. av. per cu. in.

**One deg. lat. eq.** = 110-607 kil.; 68-7 mi.

**One deg. lat. pol.** = 111-75 kil.; 69-41 mi.

**Land area** 1-4885  $\times 10^8$  sq. kil.; 5-747  $\times 10^7$  sq. mi.

**Sea area** 3-6125  $\times 10^8$  sq. kil.; 1-3948  $\times 10^8$  sq. mi.

**Highest pt. ab. sea-level** 8-84 kil.; 8840 met.; 5-492 mi.; 29,003 ft.

**Deepest pt. below sea-level** 10-43 kil.; 10,430 met.; 6-48 mi.; 34,219 ft.

**Distance (mean).** Moon 384,393 kil.; 238,854 mi. Sun 149,500,000 kil.; 92,600,000 mi. Near Star (a Cent.) 4-079  $\times 10^{18}$  cm.; 2-53  $\times 10^{18}$  mi.

**Remote Nebula** 1-3  $\times 10^{21}$  kil.; 8-06  $\times 10^{28}$  mi.

**Einstein.** A unit of energy. It is the amount of radiation which, when absorbed by a body, activates 1 gram-molecule (q.v.) of matter and is = 6-06  $\times 10^{23}$  photons or quanta or to  $Nh\nu$ , where  $N =$  Avogadro's constant (q.v.),  $h =$  Planck's C. (q.v.), and  $\nu =$  frequency. An einstein provides the means of finding the photon's (or quantum's) energy; e.g., required the energy ( $E$ ) of (a) an X-ray photon of  $10^{-7}$  cm. ( $3-9 \times 10^{-3}$  in.) w.-l. and (b) of a red-light photon of  $7 \times 10^{-5}$  cm. ( $2-73 \times 10^{-3}$  in.) w.-l. respectively: (a)  $E = h\nu = \frac{6-624}{10^{27}} \times 3 \times 10^{17} = 1-987 \times 10^{-9}$  erg per photon.

(b)  $E = h\nu = \frac{6-624}{10^{27}} \times 4-3 \times 10^{14} = 2-848 \times 10^{-12}$  erg per photon. See Faraday.

In the table the einstein and its equivalents are shown; the data in the columns are obtained as follows (take first line as an example):

(2a) w.-l. ( $\lambda$ ) is  $\frac{c}{\nu}$ , where  $c =$  vel. light (2-99  $\times 10^{10}$  cm./sec.) and  $\nu =$  freq. per sec.

(2b)  $2a \times 0-3937$  (approx. 4-0).

(3) Reciprocal of  $2a$ ; thus, a w.-l. of  $\frac{1}{5 \times 10^4}$  gives  $\frac{1}{5 \times 10^4}$  or  $2 \times 10^{-5}$  waves per cm.

(4) This is  $\frac{c}{\lambda}$ . Div. vel. light by w.-l. (col. 2a), thus  $\nu = 3 \times 10^{10} \div 5 \times 10^4 = 6 \times 10^5$ .

(5a) Mass ( $m$ ) is energy ( $E$ )  $\div c^2$ ;  $c =$  vel. light;  $\nu =$  freq.;  $h =$



ein

4

ein

Planck's constant;  $m = \frac{E}{c^2} = \frac{h\nu}{c^2}$

$$= \frac{6.624}{10^{27}} \times \frac{6 \times 10^5}{(3 \times 10^{10})^2} = 3.97 \times 10^{12} \text{ gm.}$$

(5b)  $5a \times 0.0353$ .

(6a) Energy  $E = h\nu$ , where  $h$  is Planck's constant and  $\nu$  freq.

$$Ex. E = \frac{6.624}{10^{27}} \times 6 \times 10^5 = 3.97$$

$\times 10^{12}$  ergs.

(6b)  $6a \times 7.4 \times 10^{-3}$ .

(7a) One erg =  $2.3889 \times 10^{-8}$  gm.-cals.; hence: gm.-cals. =  $3.93 \times 10^{-21} \times 2.39 \times 10^{-8} = 9.39 \times 10^{-29}$  gm.-cal.

TABLE SHOWING THE WAVE-LENGTH, FREQUENCY, MASS, AND ENERGY OF PHOTONS OR QUANTA.

| Type of Radiation.<br>1. | Wave-length, cm.<br>2a. | Wave-length, in.<br>2b. | No. of waves per cm.<br>3. | Freq. per sec.<br>4. |
|--------------------------|-------------------------|-------------------------|----------------------------|----------------------|
| Long broadcast           | $5.0 \times 10^4$       | $2.0 \times 10^4$       | $2.0 \times 10^{-5}$       | $6.0 \times 10^8$    |
| Short radio              | $1.0 \times 10^1$       | $4.0 \times 10^0$       | $1.0 \times 10^{-1}$       | $3.0 \times 10^9$    |
| Long infra-red           | $1.0 \times 10^{-2}$    | $4.0 \times 10^{-4}$    | $1.0 \times 10^2$          | $3.0 \times 10^{12}$ |
| Medium red               | $7.0 \times 10^{-5}$    | $2.8 \times 10^{-5}$    | $1.4 \times 10^4$          | $4.2 \times 10^{14}$ |
| " orange                 | $6.0 \times 10^{-5}$    | $2.4 \times 10^{-5}$    | $1.6 \times 10^4$          | $5.0 \times 10^{14}$ |
| " yellow                 | $5.6 \times 10^{-5}$    | $2.2 \times 10^{-5}$    | $1.7 \times 10^4$          | $5.3 \times 10^{14}$ |
| " green                  | $5.0 \times 10^{-5}$    | $2.0 \times 10^{-5}$    | $2.0 \times 10^4$          | $6.0 \times 10^{14}$ |
| " blue                   | $4.7 \times 10^{-5}$    | $1.9 \times 10^{-5}$    | $2.1 \times 10^4$          | $6.4 \times 10^{14}$ |
| " violet                 | $4.1 \times 10^{-5}$    | $1.6 \times 10^{-5}$    | $2.4 \times 10^4$          | $7.3 \times 10^{14}$ |
| Shortest visible         | $3.9 \times 10^{-5}$    | $1.5 \times 10^{-5}$    | $2.6 \times 10^4$          | $7.6 \times 10^{14}$ |
| Longest X-ray            | $1.0 \times 10^{-8}$    | $4.0 \times 10^{-8}$    | $1.0 \times 10^8$          | $3.0 \times 10^{18}$ |
| Short ultra-violet       | $1.3 \times 10^{-8}$    | $5.2 \times 10^{-7}$    | $7.7 \times 10^8$          | $2.3 \times 10^{18}$ |
| Long gamma-ray           | $1.4 \times 10^{-8}$    | $5.6 \times 10^{-9}$    | $7.1 \times 10^7$          | $2.1 \times 10^{18}$ |
| Shortest X-ray           | $3.0 \times 10^{-10}$   | $1.2 \times 10^{-10}$   | $3.3 \times 10^9$          | $1.0 \times 10^{19}$ |
| Short gamma-ray          | $1.0 \times 10^{-10}$   | $4.0 \times 10^{-11}$   | $1.0 \times 10^{10}$       | $3.0 \times 10^{19}$ |
| Long cosmic-ray          | $8.0 \times 10^{-12}$   | $3.2 \times 10^{-12}$   | $1.2 \times 10^{11}$       | $3.7 \times 10^{21}$ |
| Short cosmic-ray         | $3.0 \times 10^{-12}$   | $1.2 \times 10^{-12}$   | $3.3 \times 10^{12}$       | $1.0 \times 10^{23}$ |

| Type of Radiation.<br>1. | Mass of photon or quantum. |                        | Energy of photon or quantum. |                        |
|--------------------------|----------------------------|------------------------|------------------------------|------------------------|
|                          | Gm.<br>5a.                 | Oz.<br>5b.             | Ergs.<br>6a.                 | Ft./lbs.<br>6b.        |
| Long broadcast           | $4.34 \times 10^{-42}$     | $1.52 \times 10^{-43}$ | $3.930 \times 10^{-21}$      | $2.91 \times 10^{-28}$ |
| Short radio              | $2.19 \times 10^{-33}$     | $7.66 \times 10^{-40}$ | $1.965 \times 10^{-17}$      | $1.45 \times 10^{-24}$ |
| Long infra-red           | $2.19 \times 10^{-34}$     | $7.66 \times 10^{-36}$ | $1.965 \times 10^{-18}$      | $1.45 \times 10^{-26}$ |
| Medium red               | $3.12 \times 10^{-33}$     | $1.09 \times 10^{-34}$ | $2.790 \times 10^{-13}$      | $2.07 \times 10^{-19}$ |
| " orange                 | $3.66 \times 10^{-33}$     | $1.28 \times 10^{-34}$ | $3.275 \times 10^{-13}$      | $2.43 \times 10^{-19}$ |
| " yellow                 | $3.91 \times 10^{-33}$     | $1.37 \times 10^{-34}$ | $3.497 \times 10^{-13}$      | $2.59 \times 10^{-19}$ |
| " green                  | $4.39 \times 10^{-33}$     | $1.54 \times 10^{-34}$ | $3.930 \times 10^{-13}$      | $2.91 \times 10^{-19}$ |
| " blue                   | $4.67 \times 10^{-33}$     | $1.66 \times 10^{-34}$ | $4.179 \times 10^{-13}$      | $3.11 \times 10^{-19}$ |
| " violet                 | $5.35 \times 10^{-33}$     | $1.87 \times 10^{-34}$ | $4.788 \times 10^{-13}$      | $3.55 \times 10^{-19}$ |
| Shortest visible         | $5.57 \times 10^{-33}$     | $1.95 \times 10^{-34}$ | $4.984 \times 10^{-13}$      | $3.70 \times 10^{-19}$ |
| Longest X-ray            | $2.19 \times 10^{-33}$     | $7.66 \times 10^{-34}$ | $1.965 \times 10^{-11}$      | $1.45 \times 10^{-18}$ |
| Short ultra-violet       | $1.68 \times 10^{-31}$     | $5.88 \times 10^{-33}$ | $1.506 \times 10^{-10}$      | $1.11 \times 10^{-17}$ |
| Long gamma-ray           | $1.56 \times 10^{-30}$     | $5.46 \times 10^{-31}$ | $1.402 \times 10^{-9}$       | $1.04 \times 10^{-15}$ |
| Shortest X-ray           | $7.32 \times 10^{-28}$     | $2.56 \times 10^{-29}$ | $6.550 \times 10^{-7}$       | $4.81 \times 10^{-14}$ |
| Short gamma-ray          | $2.19 \times 10^{-27}$     | $7.66 \times 10^{-29}$ | $1.965 \times 10^{-6}$       | $1.45 \times 10^{-13}$ |
| Long cosmic-ray          | $2.72 \times 10^{-26}$     | $9.52 \times 10^{-28}$ | $2.456 \times 10^{-5}$       | $1.78 \times 10^{-12}$ |
| Short cosmic-ray         | $7.32 \times 10^{-21}$     | $2.56 \times 10^{-26}$ | $6.550 \times 10^{-4}$       | $4.81 \times 10^{-11}$ |

| Type of Radiation.<br>1. | Gram-calories.          |                        | Energy of photon in electron-volts.<br>8. |
|--------------------------|-------------------------|------------------------|---|
|                          | Per photon.<br>7a.      | Per einstein.<br>7b.   |   |
| Long broadcast           | $9.391 \times 10^{-29}$ | $5.691 \times 10^{-1}$ | $2.467 \times 10^{-3}$                    |
| Short radio              | $4.692 \times 10^{-28}$ | $2.843 \times 10^{-1}$ | $1.234 \times 10^{-3}$                    |
| Long infra-red           | $4.692 \times 10^{-21}$ | $2.843 \times 10^3$    | $1.234 \times 10^{-1}$                    |
| Medium red               | $6.667 \times 10^{-20}$ | $4.040 \times 10^4$    | $1.762 \times 10^0$                       |
| " orange                 | $7.825 \times 10^{-20}$ | $4.742 \times 10^4$    | $2.056 \times 10^0$                       |
| " yellow                 | $8.356 \times 10^{-20}$ | $5.064 \times 10^4$    | $2.203 \times 10^0$                       |
| " green                  | $9.390 \times 10^{-20}$ | $5.690 \times 10^4$    | $2.468 \times 10^0$                       |
| " blue                   | $9.985 \times 10^{-20}$ | $6.051 \times 10^4$    | $2.625 \times 10^0$                       |
| " violet                 | $1.144 \times 10^{-19}$ | $6.983 \times 10^4$    | $3.009 \times 10^0$                       |
| Shortest visible         | $1.190 \times 10^{-19}$ | $7.211 \times 10^4$    | $3.164 \times 10^0$                       |
| Longest X-ray            | $4.692 \times 10^{-19}$ | $2.843 \times 10^4$    | $1.234 \times 10^1$                       |
| Short ultra-violet       | $3.598 \times 10^{-18}$ | $2.182 \times 10^4$    | $9.492 \times 10^1$                       |
| Long gamma-ray           | $3.351 \times 10^{-16}$ | $2.031 \times 10^6$    | $8.814 \times 10^3$                       |
| Shortest X-ray           | $1.565 \times 10^{-14}$ | $9.484 \times 10^3$    | $4.113 \times 10^5$                       |
| Short gamma-ray          | $4.692 \times 10^{-14}$ | $2.843 \times 10^{10}$ | $1.234 \times 10^6$                       |
| Long cosmic-ray          | $5.868 \times 10^{-13}$ | $3.554 \times 10^{11}$ | $1.542 \times 10^7$                       |
| Short cosmic-ray         | $1.565 \times 10^{-11}$ | $9.484 \times 10^{13}$ | $4.113 \times 10^8$                       |

(7b) Multiply 7a by the number of photons in 1 einstein. *Ex.*  $9.39 \times 10^{-29} \times 6.06 \times 10^{23} = 5.69 = 10^{-1}$  cal./einstein.

(8) Multiply ergs per photon by no. of E.V. in 1 erg =  $6.285 \times 10^{11}$ .  
*Ex.*  $3.93 \times 10^{-21} \times 6.28 \times 10^{11} = 2.47 \times 10^{-3}$  E.V.

Einstein shift. When photons or light- and other radiation-quanta pass through a strong gravitational field, such as that surrounding our sun or a star, they are "retarded" by the "pull" or attraction of the massive body. Since a photon or quantum can only travel at the speed of light ( $2.99776 \times 10^{10}$  cm./sec. or  $9.83289 \times 10^8$  ft./sec. or 186,229 mi./sec. in *vacuo*), neither faster nor slower, the so-called "retardation" is manifested by loss of energy, decrease of frequency, and increase of w.-l. The w.-l. of light increases from the blue towards the red end of the spectrum, and hence the lines of the spectrum are *shifted* towards the red. The amount of shift (S) is given by

the equation  $S = \frac{G}{c^2} \times \frac{M}{R}$ , where G is the gravitational constant ( $6.6576 \times 10^{-8}$  c.g.s. units), c is the vel. of light, and M and R are the mass and radius of the body causing the wave-lengthening. Our sun's mass is  $1.983 \times 10^{33}$  gm., and its mean radius =

$6.953 \times 10^{10}$  cm. Hence amount of radiation shift is:

$$\frac{6.6576}{10^8} \times \frac{1}{(2.998 \times 10^{10})^2} \times \frac{1.983 \times 10^{33}}{6.953 \times 10^{10}} = \frac{2.11}{10^4}$$

or about the 1/500,000 of w.-l. Cf. Red shift.

Electroluminescence. Flashes of light sometimes seen when rubbing silk and fur, tearing surgical plaster or gutta-percha sheeting, or forcibly tearing apart mica plates. It is also seen when a tube of neon gas is shaken. The light accompanying electric discharges through gases at low temp. and p. also comes under this head. See Luminescence.

Electron. *Symb.*  $e^-$  or simply  $e$ . A fundamental particle and/or wave-group. The elementary negative chg. Its mass at low vel. ( $m_0$ ) =  $9.1066 \times 10^{-31}$  g.; at high vel. (98-0% vel. light)  $m = 4.55 \times 10^{-27}$  g.  $m$  (where  $H = 1$ ) =  $5.454 \times 10^{-4}$ . Size rad. =  $1.87 \times 10^{-13}$  cm. ( $7.48 \times 10^{-14}$  in.).

Chg. ( $e$ )  $4.8025 \times 10^{-10}$  E.S.U.  $e/c$   $1.591 \times 10^{-20}$  E.M.U.  $1.588 \times 10^{-19}$  coulomb. Spec. chg.  $5.279 \times 10^{17}$  E.S.U. per g.  $1761 \times 10^7$  E.M.U. per g.  $1.758 \times 10^8$  coul. per g.

Ratio of chg. to mass  $e/m = 1.759 \times 10^7$ ; ratio to H at 1:1847; to proton 1:1836.5. The max. vel.

known of the electron is  $2.97 \times 10^{10}$  cm./sec. or 185,628 mi./sec.; in normal H orbit its vel. is  $2.1824 \times 10^8$  cm./sec. or 1353 mi./sec. Under 20,000 volts vel. is  $8.5 \times 10^8$  cm./sec. or 52,700 mi./sec.; the vel. of an abs.-volt-electron is  $5.948 \times 10^7$  cm./sec. or 368.9 mi./sec. The av. period of the  $e$ 's rev. in an atom is  $2 \times 10^{-15}$  sec. The w.-l. of the electron varies according to its speed; e.g., at  $8.5 \times 10^8$  cm./sec. ( $5.27 \times 10^4$  mi./sec.) w.-l. is  $8 \times 10^{-12}$  cm. ( $3.12 \times 10^{-10}$  in.); at  $6.09 \times 10^8$  cm./sec. ( $0.377$  mi./sec.) w.-l. is  $10^{-11}$  cm. ( $3.9 \times 10^{-10}$  in.); and at  $1.0$  cm./sec. ( $0.39$  in./sec.) w.-l. is  $7.0$  cm. ( $2.73$  in.). The w.-l. of one abs.-volt-electron is  $1.221 \times 10^{-7}$  cm. ( $4.76 \times 10^{-9}$  in.). The freq. of an  $e$  is  $1.24 \times 10^{16}$  oscillations per sec. The energy,  $mc^2$ , is  $10^{10}$ – $10^{14}$  E.V. ( $1.0$  E.V. =  $1.591 \times 10^{13}$  erg) or  $1.591 \times 10^{-1}$  to  $1.591 \times 10^3$  erg. No. of electrons in the einstein universe  $1.5 \times 10^{79}$ .

**Energy associated with unit wave number.** *Symb.*  $hc$  (Planck's constant  $\times$  vel. light) =  $1.9627 \times 10^{-16}$  erg cm.  $1.2385 \times 10^{-4}$  E.V. cm.

**Equipartition of energy.** The principle that the molecules of a gas under the same pressure maintain the same average distance apart and possess the same average kinetic energy (K.E.). K.E. = abs. temp.  $\times$  Boltzmann's constant (*q.v.*).

**Excited atom.** An atom with one or more electrons moving at higher energy levels than those proper to a "normal atom" (*q.v.*). See Atom.

**Fluorescence.** Cert. bodies have the property of absorbing a radiation and subsequently of emitting visible light of a longer w.-l. than that of the radiation absorbed; such bodies are said to be fluorescent. The coloured light displayed by the glass of an X-ray tube is an example—yellow-green for soda-glass, blue-green for lead-glass—and is caused by the impact of electrons on the glass. Diamonds and rubies fluoresce under kathode rays. The fl. of barium-platino-cyanide under kathode-rays is used in X-ray work. Luminous paints contain minute portions of radium, the emitted particles from which, falling on zinc sulphide, cause it to fluoresce. The blue and red light of solutions of quinine and chlorophyll respectively are fl.'s consequent on previous irradiation of the solutions by short ultra-violet rays with the subsequent emission of

visible light-rays of longer w.-l. See Luminescence; cando-l.; also see Fluorescence, p. 85.

**Fluoroluminescence.** "Cold" light given off by a substance in less than  $10^{-8}$  sec. after irradiation. Possibly a form of phosphorescence (*q.v.*). See Luminescence.

**Formula weight.** Molecular wt. in grams. One mol. (*q.v.*).

**F.P.S.** Foot, pound, second system of units. Cf. C.G.S.

**Galvanoluminescence.** Light that appears during electrolysis of a solution at the anode or kathode. See Luminescence.

**Gram-atom.** *Syn.* Gram-atomic-wt. Weight in grams numerically = at. wt.

**Gram-atomic-weight.** Gram-atom (*q.v.*).

**Gram-equivalent.** Wt. in grams numerically = chemical equivalent (*q.v.*).

**Gram-formula-weight.** Wt. in grams numerically = formula-wt. Molecular wt in grams. Mol.

**Gram-mole.** Wt. in grams numerically = molecular wt. There are  $6.06 \times 10^{23}$  molecules in a gm.-mole. *Syn.* Gram-molecule. Gram-molecular wt.

**Gram-molecular-weight.** Gram-mole. (*q.v.*).

**Gram-molecule.** Gram-mole. (*q.v.*).

**Gravitation.** *Acceleration* (nor.) ( $g_n$ )  $980.665$  cm./sec.<sup>2</sup> or  $32.174$  ft./sec.<sup>2</sup>; at  $45^\circ$  ( $g_u$ )  $980.616$  cm./sec.<sup>2</sup> or  $32.164$  ft./sec.<sup>2</sup>.

*G. constant*  $6.664 \times 10^{-8}$  dyne cm.<sup>2</sup>-g.<sup>-1</sup>;  $6.664 \times 10^{-11}$  gm. cm.<sup>2</sup>/g.<sup>-1</sup>.

*Length of one-sec. pendulum and acceleration.*  $0^\circ$  lat. ( $E_q$ )  $l = 99.0961$  cm. or  $39.014$  in.;  $a = 978.039$  cm./sec.<sup>2</sup> or  $32.088$  ft./sec.<sup>2</sup>.  $30^\circ$  lat.  $l = 99.2268$  cm. or  $39.0656$  in.;  $a = 979.329$  cm./sec.<sup>2</sup> or  $32.130$  ft./sec.<sup>2</sup>.  $60^\circ$  lat.  $l = 99.4891$  cm. or  $39.169$  in.;  $a = 981.918$  cm./sec.<sup>2</sup> or  $32.215$  ft./sec.<sup>2</sup>.  $90^\circ$  lat. (Po.)  $l = 99.6207$  cm. or  $39.221$  in.;  $a = 983.217$  cm./sec.<sup>2</sup> or  $32.258$  ft./sec.<sup>2</sup>.

*G. "Pull" of.* Following are some examples of the "pull" ( $p$ ) between two bodies  $a$  and  $b$  (and on each of them) of various masses and distances apart. The formula used is:

$F = K \frac{m \times m^1}{d^2}$ , where  $F$  is the force of gravitation in grams-weight,  $K = G$  = the constant of gravitation =  $6.6607 \times 10^{-11}$  cm.<sup>2</sup> g.s.<sup>2</sup> (gram-wt.) or  $6.6607 \times 10^{-8}$  cm.<sup>2</sup> g.s.<sup>2</sup> (dynes);  $m$  and  $m^1$  are the masses in grams of

the two bodies and  $d$  the distance separating their two centres.

(1.) (a) Andromeda nebula (M.31) and (b) our Milky Way System of nebulae and stars:

$m$  (a)  $7.09 \times 10^{41}$  g. ( $7.17 \times 10^{36}$  l. ton).

$m$  (b)  $2.03 \times 10^{43}$  g. ( $1.99 \times 10^{37}$  l. ton).

$d$   $8.514 \times 10^{21}$  cm. ( $5.28 \times 10^{13}$  mi.).

$p$   $1.3267 \times 10^{21}$  g. ( $1.3 \times 10^{21}$  l. ton).

(2.) Two "island universes" of average mass and av. dist. apart:

$m$  (a) and  $m$  (b)  $1.37 \times 10^{43}$  g. ( $1.34 \times 10^{37}$  l. ton).

$d$   $1.893 \times 10^{24}$  cm. ( $1.17 \times 10^{13}$  mi.).

$p$   $3.501 \times 10^{27}$  g. ( $3.444 \times 10^{21}$  l. ton).

(3.) Sun and planet Jupiter:

$m$  (a)  $2.024 \times 10^{33}$  g. ( $1.992 \times 10^{27}$  l. ton).

$m$  (b)  $2.124 \times 10^{30}$  g. ( $2.09 \times 10^{24}$  l. ton).

$d$   $7.723 \times 10^{13}$  cm. ( $4.8 \times 10^7$  mi.).

$p$   $4.791 \times 10^{33}$  g. ( $4.71 \times 10^{27}$  l. ton).

(4.) Sun and Earth:

$m$  (a)  $2.024 \times 10^{33}$  g. ( $1.992 \times 10^{27}$  l. ton).

$m$  (b)  $6.7 \times 10^{27}$  g. ( $6.59 \times 10^{21}$  l. ton).

$d$   $1.485 \times 10^{13}$  cm. ( $9.22 \times 10^7$  mi.).

$p$   $4.105 \times 10^{33}$  g. ( $4.04 \times 10^{27}$  l. ton).

(5.) Earth and Moon:

$m$  (a)  $6.7 \times 10^{27}$  g. ( $6.59 \times 10^{21}$  l. ton).

$m$  (b)  $7.62 \times 10^{22}$  g. ( $7.5 \times 10^{16}$  l. ton).

$d$   $3.844 \times 10^{10}$  cm. ( $2.38 \times 10^5$  mi.).

$p$   $2.305 \times 10^{22}$  g. ( $2.26 \times 10^{16}$  l. ton).

(6.) Two average "Island Universes" on opp. sides of Einstein cosmos:

$m$  (a) and  $m$  (b)  $1.37 \times 10^{43}$  g. ( $1.34 \times 10^{37}$  l. ton).

$d$   $9.656 \times 10^{27}$  cm. ( $5.99 \times 10^{21}$  mi.).

$p$   $1.332 \times 10^{29}$  g. ( $1.31 \times 10^{23}$  l. ton).

(7.) Our solar system and one of nearest 2-star system ( $\alpha$ - $\beta$  Centauri):

$m$  (a)  $4.277 \times 10^{33}$  g. ( $4.209 \times 10^{27}$  l. ton).

$m$  (b)  $2.027 \times 10^{33}$  g. ( $1.995 \times 10^{27}$  l. ton).

$d$   $4.079 \times 10^{13}$  cm. ( $2.53 \times 10^{13}$  mi.).

$p$   $3.469 \times 10^{33}$  g. ( $3.41 \times 10^{27}$  l. ton).

(8.) Two 14-stone men 3.0 feet apart:

$m$  (a) and  $m$  (b)  $8.89 \times 10^4$  g. (196.0 lb. av.).

$d$   $91.44$  cm. (3.0 ft.).

$p$   $6.2 \times 10^{-6}$  g. ( $2.188 \times 10^{-6}$  oz. av.).

(9.) Two gram-weights 1.04 inch apart:

$m$  (a) and  $m$  (b)  $1.0$  g. ( $3.527 \times 10^{-3}$  oz. av.).

$d$   $2.54$  cm. (1.0 in.).

$p$   $1.023 \times 10^{-21}$  g. ( $3.58 \times 10^{-23}$  oz. av.).

(10.) Two bodies, each mass of our earth, on opp. sides of Einstein universe:

$m$  (a) and  $m$  (b)  $6.7 \times 10^{27}$  g. ( $6.59 \times 10^{21}$  l. ton).

$d$   $9.656 \times 10^{27}$  cm. ( $5.99 \times 10^{21}$  mi.).

$p$   $3.21 \times 10^{-11}$  g. ( $1.1235 \times 10^{-13}$  oz. av.).

(11.) Two 14-stone men on opp. sides of earth's equator:

$m$  (a) and  $m$  (b)  $8.89 \times 10^4$  g. (196 lb. av.).

$d$   $1.275 \times 10^9$  cm. (7926.68 mi.).

$p$   $3.256 \times 10^{-19}$  g. ( $1.151 \times 10^{-20}$  oz. av.).

(12.) Two bodies each mass of a 14-st. man, on opp. sides of Einstein universe:

$m$  (a) and  $m$  (b)  $8.89 \times 10^4$  g. (196 lb. av.).

$d$   $9.656 \times 10^{27}$  cm. ( $5.99 \times 10^{21}$  mi.).

$p$   $5.58 \times 10^{-27}$  g. ( $1.969 \times 10^{-28}$  oz. av.).

(13.) Two hydrogen atoms one inch apart:

$m$  (a) and  $m$  (b)  $1.662 \times 10^{-24}$  g. ( $5.817 \times 10^{-25}$  oz. av.).

$d$   $2.54$  cm. (1.0 in.).

$p$   $2.818 \times 10^{-48}$  g. ( $9.863 \times 10^{-51}$  oz. av.).

(14.) Two electrons an inch apart:

$m$  (a) and  $m$  (b)  $9.04 \times 10^{-28}$  g. ( $3.164 \times 10^{-29}$  oz. av.).

$d$   $2.54$  cm. (1.0 in.).

$p$   $8.359 \times 10^{-68}$  g. ( $2.926 \times 10^{-67}$  oz. av.).

(15.) Two gram weights on opp. sides of Einstein universe:

$m$  (a) and  $m$  (b)  $1.0$  g. ( $3.527 \times 10^{-3}$  oz. av.).

$d$   $9.656 \times 10^{27}$  cm. ( $5.99 \times 10^{21}$  mi.).

$p$   $7.15 \times 10^{-47}$  g. ( $2.502 \times 10^{-48}$  oz. av.).

(16.) Two hydrogen atoms on opp. sides of Einstein universe:

$m$  (a) and  $m$  (b)  $1.662 \times 10^{-24}$  g. ( $5.817 \times 10^{-25}$  oz. av.).

$d$   $9.656 \times 10^{27}$  cm. ( $5.99 \times 10^{21}$  mi.).

$p$   $2.0 \times 10^{-114}$  g. ( $7.06 \times 10^{-113}$  oz. av.).

(17.) Two electrons on opp. sides of Einstein universe:

$m$  (a) and  $m$  (b)  $9.04 \times 10^{-28}$  g. ( $3.16 \times 10^{-29}$  oz. av.).

$d$   $9.656 \times 10^{27}$  cm. ( $5.99 \times 10^{21}$  mi.).

$p$   $5.78 \times 10^{-121}$  g. ( $2.04 \times 10^{-122}$  oz. av.).

Hallwach effect. Photoelectric effect (q.v.).

Hydrogen atom. Radius (i.e., of

normal electron orbit)  $5.281 \times 10^{-4}$  cm. ( $2.059 \times 10^{-4}$  in.).

Island universe; dimensions of an average. *Dia.*  $1.224 \times 10^{22}$  cm. ( $7.6 \times 10^{17}$  mi.).

*Circ.*  $3.8434 \times 10^{22}$  cm. ( $2.386 \times 10^{14}$  mi.).

*Surf. area*  $4.674 \times 10^{46}$  sq. cm. ( $1.814 \times 10^{38}$  sq. mi.).

*Vol.*  $9.17 \times 10^{33}$  c.c. ( $2.195 \times 10^{25}$  cu. mi.).

*Mass*  $2.034 \times 10^{42}$  g. ( $2.002 \times 10^{27}$  l. ton).

*Density*  $2.175 \times 10^{-26}$  g./c.c. ( $1.25 \times 10^{-28}$  oz./cu. in.).

Jupiter, our largest planet. *Dia.*  $1.436 \times 10^{10}$  cm. ( $8.923 \times 10^4$  mi.).

*Circ.*  $4.48 \times 10^{10}$  cm. ( $2.8 \times 10^4$  mi.).

*Surf. area*  $6.405 \times 10^{22}$  sq. cm. ( $2.437 \times 10^{14}$  sq. mi.).

*Vol.*  $1.476 \times 10^{23}$  c.c. ( $3.548 \times 10^{14}$  cu. mi.).

*Mass*  $1.941 \times 10^{30}$  g. ( $1.911 \times 10^{24}$  l. ton).

*Density*  $1.333$  g./c.c. ( $0.7$  oz. av./cu. in.).

*Light. Sym. c.* Vel. in vacuo.  $2.99776 \times 10^{10}$  cm./sec. ( $186,229$  mi./sec.).

Pressure of sunlight  $1.4957 \times 10^{12}$  cm. ( $92,900,000$  mi.) from sun =  $4.588 \times 10^{-4}$  gm./sq. cm. or  $6.527 \times 10^{-10}$  lb. av./sq. in.  $2.6107$  lb./sq. mi.

Pressure on earth (i.e., on  $\frac{1}{2}$  surface)  $1.1613 \times 10^{11}$  grams or  $1.147 \times 10^5$  l. tons. In the interior of the sun the light or radiation p. is vastly greater, viz.:  $1.2305 \times 10^{12}$  lb./sq. inch or  $2.197 \times 10^{16}$  ton/sq. mile. See p. 119, and also under Photon.

Lightning flash. Av. energy  $10^{11}$  ergs.  $6.285 \times 10^{10}$  E.V. Av. potl.  $10^9$  volt.

Lorentz-Fitzgerald contraction. A relativity hypothesis that the length of a body becomes reduced in the direction in which it moves through an assumed motionless medium. The contraction is in the ratio of  $\sqrt{1 - \frac{U^2}{C^2}}$

to 1.0, where U is the vel. of the body and C of light.

Loschmidt number. The number ( $2.705 \times 10^{19}$ ) of molecules per c.c. of a gas at  $0^\circ$  C. and  $76.0$  cm. p.

Luminescence. The emission, under the influence of various agents, and usually at normal temp., of "cold" light, i.e., of light without appreciable rise of temp. See Fluorescence; Phosphorescence, Anodo-, Bio-, Ca-

thodo-, Crystallo-, Electro-, Fluoro-, Galvano-, Oxy-, Phospho-, Photo-, Pyro-, Radio-, Sono-, Thermo-, Triboluminescence.

Lyman series. The first group of H spectrum bands between w.-l. of  $1.2 \times 10^{-4}$  cm. and  $1.5 \times 10^{-4}$  cm. The frequencies of these bands are multiples of the series:

$$\left(1 - \frac{1}{2^2}\right)\left(1 - \frac{1}{3^2}\right)\left(1 - \frac{1}{4^2}\right) \dots \left(1 - \frac{1}{n^2}\right),$$

n being a whole number. The lines are in the ultra-violet spectrum, and are caused by the "jump" of electrons from orbits 2 and 3 into orbit 1. Cf. Balmer, Schumann, Paschen.

Magnetic resonance accelerator. Cyclotron (q.v.).

Magnetron. A fundamental unit of magnetism. It is the "magnet" represented by an electron moving in the normal orbit of  $5 \times 10^{-9}$  cm. radius of the H atom.

Meson. Mesotron (q.v.).

Meson. Syn. Meson-Yukawa particle. A high-energy sub-atomic particle—possibly the penetrating component of cosmic rays. Its energy ( $10^4$  E.V. or  $1.59 \times 10^{-4}$  erg) and mass ( $8.99 \times 10^{-24}$  g.) enable it to penetrate 2.0 met. (6.56 ft.) of lead. Its mass is thus intermediate between that of a proton ( $1.66 \times 10^{-24}$  g.) and an electron ( $9.088 \times 10^{-28}$  g.). M.'s are at their max. at the 16.0-km. (10-mile) level of the atmosphere, where they are 9 times more abundant than on earth. Actual 2-minute counts showed 10 at 580 ft., 14 at 5200 ft., 19 at 10,816 ft., and 24 at 14,259 ft. The av. life of a m. is but  $2 \times 10^{-6}$  sec. The symbol is U, and there are, apparently, + and - types. They may result (1) from action of a high-energy quantum ( $h\nu$ ) (e.g., cosmic ray) on the proton (P) of the H atom, or (2) from action of a quantum on a neutron (N). Such actions may be reversible, thus:

(1)  $h\nu + P \longleftrightarrow N + U^+$   
quantum proton neutron + mesotron.

(2)  $h\nu + N \longleftrightarrow P + U^-$   
quantum neutron proton -mesotron.

Mol, mole. A gram-molecule (q.v.). The formula-wt. (q.v.) in grams. Thus, a mol of water,  $H_2O = 2 + 16 = 18$  gm.; a mol of nitric acid,  $HNO_3 = 1 + 14 + 48 = 63$  gm.

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**Moon.** *Dia.*  $3.475 \times 10^8$  cm. ( $2.16 \times 10^3$  mi.).

*Circ.*  $1.09 \times 10^8$  cm. ( $6.782 \times 10^3$  mi.).

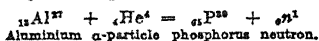
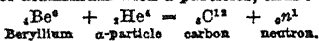
*Surf. area*  $3.78 \times 10^{17}$  sq. cm. ( $1.463 \times 10^7$  sq. mi.).

*Vol.*  $2.03 \times 10^{22}$  c.c. ( $5.038 \times 10^9$  cu. mi.).

*Mass*  $7.62 \times 10^{22}$  g. ( $7.5 \times 10^{18}$  l. ton).

*Density*  $3.428$  g./c.c. ( $2.098$  oz./cu. in.).

**Neutron.** *Sym.*  $n$ .  ${}^1_0\text{H}$ . *At. no.* 0. *At. wt.* 1.0085. *Mass*  $1.67339 \times 10^{-24}$  g. The  $n$  is an entity of atomic nucleus (H excepted) within which it exists in company with protons, the mean distance between the closely-packed units being  $3 \times 10^{-13}$  cm. ( $1.182 \times 10^{-13}$  in.). A He at. contains  $2n + 2p$  an O at.,  $8n + 8p$ ; in a Ra at. the  $n$ 's are in excess,  $138n + 88p$ . The  $n$  is probably at bottom a proton and electron in close union, the distance between them being greater than  $1.87 \times 10^{-13}$  cm. ( $7.368 \times 10^{-14}$  in.), for, when so close together as this, they form a *photon* (*q.v.*). A  $n$  state of matter, such as probably exists in cert. dwarf stars, is exceedingly dense— $10^{14}$  g./c.c. ( $5.78 \times 10^{13}$  oz. av./c. in.) (mean d. of our earth is 5.5 g./c.c. or 3.195 oz. av./cu. in.). A  $n$  can be thrown out of a nucleus by a photon, and is then called a *photoneutron*. The  $n$  is a good bullet for breaking up the nuclei of at.; it can penetrate an inch of lead. Neutrons, as separate entities, can be obtained by bombarding beryllium or aluminium with  $\alpha$ -particles, thus:



**Normal.** *Phy.* line or plane perpendicular to another line or plane. *N. atom.* Atom with neither surplus nor deficit of valence electrons, and in which the latter hold their usual relation to the nucleus. *Cf.* Excited atom. *N. pressure.* The p. of one atmosphere or the p. which balances a column of mercury at  $0^\circ\text{C}$ .  $76.0$  cm. ( $29.921$  in.) high. It =  $1.0332$  kg./sq. cm. or  $14.696$  lb. av./sq. in. ( $10.3320$  kg./sq. met. or  $2116.2$  lb. av./sq. ft.);  $1033.2$  g./sq. cm.;  $1.01325 \times 10^5$  dynes/sq. cm. A col. of water at  $39.1^\circ\text{F}$ . ( $3.95^\circ\text{C}$ .)  $33.899$  ft. high = n.p. or 1 atm. *N. salt.* Since a salt is obtained by replacing the H of an acid by a metal, and is

therefore a substance which can yield ions (other than  $\text{H}^+$  or  $\text{OH}^-$  ions), a N. salt may be defined as an ionic compound containing no replaceable  $\text{H}^+$  or  $\text{OH}^-$  ions. A N. salt is also formed when an acid radical (*e.g.*, the  $\text{Cl}^-$  of  $\text{HCl}$ , or the  $\text{SO}_4^{2-}$  of  $\text{H}_2\text{SO}_4$ ) takes the place of the  $\text{OH}$  radical of a base; thus,  $\text{Na}_2\text{SO}_4$  is a N. salt, but  $\text{NaHSO}_4$  is an acid salt. *N. solution.* (*Sym.* *N.*) A solution holding 1.0 gram-molecular-wt. (*q.v.*) of the dissolved substance  $\div$  its H-equivalent (*i.e.*, 1.0 gram-equivalent) per litre. Thus, normal  $\text{HNO}_3$  =  $1.0 + 14.008 + 3 \times 16 = 63.01$  g.  $\text{HNO}_3$  per litre; normal  $\text{HCl}$  contains  $1.0 + 35.5 = 36.5$  g.  $\text{HCl}$  per litre. *See* Normality. *N. temperature.* (1) Ordinary living-room temp. (2) Temp. of healthy human adult ( $98.6^\circ\text{F}$ ,  $36.95^\circ\text{C}$ ).

**Normality.** Concentration of a solution in gram-equivalents per litre; thus,  $\text{N}$ -,  $3\text{N}$ -, and  $0.5\text{N}$ -solutions stand respectively for 1.0 g., 3.0 g., and 0.5 g. equivalent per litre. *See* N. solution.

**Nucleus of atom.** *Dia.* av.  $10^{-13}$  to  $10^{-15}$  cm. ( $3.9 \times 10^{-13}$  to  $3.9 \times 10^{-14}$  in.). The dia. of the nucleus of a medium-sized at., *e.g.* silver, is  $1.27 \times 10^{-13}$  cm. ( $5.004 \times 10^{-13}$  in.). A large nucleus, such as that of the most massive at., uranium, has a dia. of  $1.4 \times 10^{-13}$  cm. ( $5.46 \times 10^{-13}$  in.), while the dia. of the whole at. is  $4.2 \times 10^{-8}$  cm. ( $1.633 \times 10^{-8}$  in.)—*i.e.*, 3000 times that of the nucleus. The vol. of the U at. is  $3.35 \times 10^{-23}$  c.c. ( $2.043 \times 10^{-24}$  cu. in.), but vol. of nucleus is only  $1.44 \times 10^{-23}$  c.c. ( $8.784 \times 10^{-23}$  cu. in.). The nucleus of the lightest at., hydrogen, consists of one proton, the nucleus of heavier atoms consists of protons and neutrons having an av. distance apart of  $3 \times 10^{-13}$  cm. ( $1.182 \times 10^{-13}$  in.).

**Organoluminescence.** *Sym.* Bioluminescence (*q.v.*).

**Oxyluminescence.** The "cold" light emitted during cert. oxidative reactions. *Sym.* Chemiluminescence (*q.v.*).

**Paschen series.** Hydrogen spectrum lines in infra-red region caused by the fall of electrons from an outer into the 3rd orbit; their frequencies are multiples of the series  $\left(\frac{1}{9} - \frac{1}{m^2}\right)$ , where  $m$  has the whole number values 4, 5, 6, . . . *Cf.* Balmer, Lyman, Schumann.

**pH.** The potential (p.) of hydro-

gen (H). It expresses the *degree* of acidity or of alkalinity. Acidity is caused by excess of H ions in an aqueous solution; alkalinity is the reverse. pH is really the *log*. of the reciprocal of the H-ion concentration ( $pH = \log. 1/c \text{ H}^+$ ). Water dissociates but slightly; a litre (1000.0 g.) holds only  $10^{-7}$  g. ion of  $\text{H}^+$  ions and  $10^{-7}$  g. ion of  $\text{OH}^-$  ions; in other words, one g. ion of either  $\text{H}^+$  or  $\text{OH}^-$  is present in  $10^7$  litres ( $10^{10}$  g.) of  $\text{H}_2\text{O}$ . A neutral solution has the same concentration of  $\text{H}^+$  and  $\text{OH}^-$  ions as water, the pH of which is 7.0. It follows that a litre (1000 g.) of  $\text{H}_2\text{O}$  represents  $10^{-7}$  g.  $\text{H}^+$  plus  $10^{-7}$  g.  $\text{OH}^-$  and that  $7p\text{H}^+ + 7p\text{OH}^- = \text{constant } 14.0$ . Solutions  $p\text{H}^0$ ,  $p\text{H}^*$ ,  $p\text{H}^1$ ,  $p\text{H}^2$ ,  $p\text{H}^3$  indicate respectively "very," and "slightly," acid, neutral, "slightly," and "very," alkaline.

escence is lessened or annulled by red and infra-red rays. The light of P. and of fireflies, etc., is not a phosphorescence.

**Photoelectric effect.** Hallwachs (1888) discovered that ultra-violet light falling on cert. negatively-charged metals discharged them by throwing out electrons. This phenomenon—known as *Hallwachs'*, or *photoelectric effect*—may be defined as the ejection of electrons by cert. metals (such as K and Na) when light or other radiation falls on them, the metals being left in a + state. The ejected electrons are known as *photo-electrons*. Increase in intensity of the incident light does *not* increase the energy of departure of the electrons, but it increases the number thrown out. The fact that the electrons pour forth *immediately* the radiation

TABLE SHOWING pH VALUES OR DEGREES OF ACIDITY AND ALKALINITY.  
(Modified from Hackh's *Chemical Dictionary*.)

| pH: | H <sup>+</sup> -ion concentration<br>in mols. per litre<br>(n grams H <sup>+</sup> per litre).<br>N = normal. | OH <sup>-</sup> -ion concentration<br>in mols. per litre<br>( <sup>1</sup> / <sub>n</sub> grams OH <sup>-</sup> per litre).<br>N = normal. | pOH. |
|-----|---|--|------|
| 0   | 1.0 N.  | Very acid.   | 14   |
| 1   | $10^{-1}$ N.  |  | 13   |
| 2   | $10^{-2}$ N.  | Acid.  | 12   |
| 3   | $10^{-3}$ N.  |  | 11   |
| 4   | $10^{-4}$ N.  |  | 10   |
| 5   | $10^{-5}$ N.  | Slightly acid.   | 9    |
| 6   | $10^{-6}$ N.  |  | 8    |
| 7   | $10^{-7}$ N.  | Neutral.   | 7    |
| 8   | $10^{-8}$ N.  |  | 6    |
| 9   | $10^{-9}$ N.  | Slightly alkaline.   | 5    |
| 10  | $10^{-10}$ N.   |  | 4    |
| 11  | $10^{-11}$ N.   |  | 3    |
| 12  | $10^{-12}$ N.   | Alkaline.  | 2    |
| 13  | $10^{-13}$ N.   |  | 1    |
| 14  | $10^{-14}$ N.   | Very alkaline.   | 0    |

**Phospholuminescence.** Light emitted by phosphorus when exposed to air. Chemiluminescence (*q.v.*).

**Phosphorescence.** Emission of light by a substance that has previously absorbed a radiation. It is manifested by cert. "impure" sulphides, *e.g.*, those of Ba, Ca, Sr, and Zn. Sulphate of barium (solar or Bologna phosphorus) is extremely phosphorescent. At the temp. of liquid air many bodies, even ice, become phosphorescent. Phosphor-

strikes the metallic surface without any time-lag points to a particulate form of radiation; the "particles" are known as "photons" or "quanta." The velocity and energy of the expelled electrons increase with increase of frequency and decrease of w.l. of the incident radiation (photon), and *vice versa*. The energy of a photon is its frequency ( $\nu$ )  $\times$  Planck's constant ( $h$ ),  $E = h\nu$ , and the energy of the ejected electron is the energy of the photon less a con-

stant quantity ( $W$ ) characteristic of the metal.  $E = h\nu - W$ . If the w.-l. of the radiation is longer than a cert. value no electrons are thrown out of the metal, and the limit line between emission and retention of electrons is called the Photoelectric threshold.

**Photoelectron.** See Photoelectric effect.

**Photoluminescence.** Emission of light by a body in virtue of its previous stimulation of ultra-violet or visible light. See Luminescence.

sends out about  $10^{22}$  p.'s per sec. of w.-l.  $5 \times 10^4$  cm. (1640 ft.). An ordinary electric glow-lamp emits  $10^{18}$  p.'s per sec. of w.-l. of about  $4.5 \times 10^{-5}$  cm. ( $1.773 \times 10^5$  in.). The p. is regarded as a proton and electron in very intimate union, i.e., at a distance from one another = rad. of electron, or  $1.87 \times 10^{-13}$  cm. ( $7.367 \times 10^{-14}$  in.). The mass of a p.—which may exceed that of an electron which is  $= 9.1 \times 10^{-28}$  g.—increases with decrease of w.-l. and increase of frequency, thus:

|                            | Wave-length.            | Freq./Sec.           | Mass Grams.            |
|----------------------------|-------------------------|----------------------|------------------------|
| 1. Wireless p. . . . .     | $2 \times 10^4$ cm.     | $1.5 \times 10^8$    | $1.09 \times 10^{-11}$ |
| 2. Infra-red p. . . . .    | $8 \times 10^{-5}$ cm.  | $3.6 \times 10^{14}$ | $2.63 \times 10^{-13}$ |
| 3. Green light p. . . . .  | $5 \times 10^{-5}$ cm.  | $6.0 \times 10^{14}$ | $4.39 \times 10^{-13}$ |
| 4. Ultra-violet p. . . . . | $2 \times 10^{-5}$ cm.  | $1.5 \times 10^{15}$ | $1.09 \times 10^{-13}$ |
| 5. X-ray p. . . . .        | $1 \times 10^{-7}$ cm.  | $3.0 \times 10^{17}$ | $2.19 \times 10^{-16}$ |
| 6. Gamma-ray p. . . . .    | $1 \times 10^{-9}$ cm.  | $3.0 \times 10^{19}$ | $2.19 \times 10^{-18}$ |
| 7. Cosmic-ray p. . . . .   | $1 \times 10^{-12}$ cm. | $3.0 \times 10^{22}$ | $2.19 \times 10^{-21}$ |

**Photon.** *Sym.*  $\epsilon$ . Quantum of radiation. *Sym.*  $\epsilon$ . A neutral entity which may be free or bound to matter and which may be regarded as a "particle" and/or a coherent train of waves. The p. has vel., mass, inertia, momentum, frequency, wave, and particle characteristics which can all vary except the vel. which is constant, being, in a vacuum,  $2.99776 \times 10^{10}$  cm./sec. or 186,229 mi./sec. P.s do not interact with one another, but only with ordinary matter. After collision with a matter-particle the joint momentum of the 2 entities after collision is the same as that before; in this way the energy and freq. of the p. are decreased, its w.-l. increased, while its vel. remains unchanged. The energy of the p. increases with decrease of its w.-l. A p. can knock an electron out of an at., or it can make it shift its position (orbit) within the at. In so doing the p. may pass through the at., or it may become absorbed by the at., the latter then passing from a lower to a higher energy-level. Conversely, when an at. slips down from a higher to a lower energy-level a p. or quantum is released and leaves the at. There are hertzian, wireless, infra-red, visible light, ultra-violet, X-ray, gamma-ray, and cosmic-ray p.'s, the description given being in order of decreasing w.-l., but increasing energy and frequency. An ordinary broadcasting transmitter

The mass of a p. is its energy  $\div$  (vel. light)<sup>2</sup>  $h\nu/c^2$ . Other relationships are:

$$m = h/T \times c^2 = h/c \times \lambda = \frac{E}{c^2}$$

$$\lambda = h/p = hc/E = T \times c = c/\nu$$

$$c = h/\lambda \times m = p/m = E/p = h\nu/p$$

$$= E\lambda/h = h/Tp = \lambda/T = \lambda\nu = \sqrt{E}/\sqrt{m} \text{ (or } c^2 = E/m)$$

$$\nu = E/h = cp/h = 1/T = e/\lambda$$

$$h = E/\nu = ET = pc/\nu = p\lambda = E\lambda/c$$

$$= Tpc = Tmc^2$$

$$T = h/E = h/pv = h/mc^2 = 1/\nu = \lambda/c$$

where  $h$  = Planck's constant =  $6.624 \times 10^{-27}$  erg sec.  $\nu$  = freq. per sec.  $c$  = vel. light ( $2.99776 \times 10^{10}$  cm./sec.).  $m$  = mass in grams.  $T$  = time of freq. in sec.  $\lambda$  = w.-l. in cm.  $E$  = energy in ergs.  $p$  = mass-vel. = momentum.

**Photoneutron.** See Neutron.

**Piezoluminescence.** Triboluminescence (q.v.).

**Positive rays.** Anode rays (q.v.).

**Proton.** *Sym.*  ${}^1\text{H}^+$  or  $\text{H}^+$  or  $p$  or  ${}^1_1\text{e}^+$ . At. no. 1. Physical at. wt. 1.0072. Abs. at. wt.  $1.661 \times 10^{-24}$  g. Rad.  $1.2 \times 10^{-18}$  cm. Mass (Mp)  $1.67248 \times 10^{-24}$  g. Mass ratio to electron 1836.5:1.

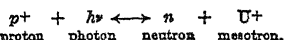
*Charge*  $e$   $4.77 \times 10^{-10}$  E.S.U.  $e/e$   $1.591 \times 10^{-20}$  E.M.U.  $1.588 \times 10^{-20}$  coulombs.

*Spec. chg.*  $9.5797 \times 10^8$  E.M.U./g.  $2.871 \times 10^{14}$  E.S.U./g.  $9.557 \times 10^4$  coul./g.



The p. is an entity of atomic nuclei, and in an av. nucleus with a dia. of  $10^{-13}$  cm. ( $3.94 \times 10^{-13}$  in.) it is closely-packed with neutrons, the av. distance apart being  $3.0 \times 10^{-13}$  cm. ( $1.182 \times 10^{-13}$  in.). The p. behaves as a group-wave and/or a particle; its electric chg. is +, and it is therefore deflected by a magnet in a contrary direction to that of the electron. The vel. of a p. going towards the kathode of a vacuum-tube is, in virtue of its greater mass, much less than that of the electron moving simultaneously towards the anode, but the energies  $\left(\frac{MV^2}{2}\right)$  are

— The freq. of the p.,  $2.29 \times 10^{23}$  vib./sec., is much greater than that of an electron. A p. that succeeds in absorbing a high-energy photon or quantum gives rise to a neutron and + mesotron, and the converse process may also occur, the collision of a mesotron and neutron producing a photon and proton, thus:



**Pyroluminescence.** Light emitted by "excited atoms" (q.v.), with resulting recombination of ions to form molecules. Low-temp. flames, such as that of carbon bisulphide, rich in ultra-violet rays come under this head, as also do the coloured flames of cert. elements, such as the red of Li, the crimson of Sr, the yellow of Na, green of Ba, and the blue of Cu. See Luminescence.

**Radioluminescence.** Emission of light from a substance that has been previously irradiated with X-rays—a variety of phosphorescence (q.v.).

**Raman effect.** When monochromatic light, i.e. light of one w.-l. such as that of a mercury lamp, falls on cert. substances, it suffers "scattering." At first the scattered light has the same w.-l. as the incident light, but presently light of other w.-l. begins to appear, either of longer or of shorter w.-l. than the incident. The phenomenon is regarded as an absorption by the scattering material of some of the photons (quanta) and their transformation into photons of different w.-l. and frequency. It is probable the photon after altering the energy of the atom is re-radiated at a modified w.-l. and freq. The phenomenon contributes further evidence of the particulate nature of

photons. Cf. Photoelectric and Compton effects.

**Red shift.** Shift of lines of the visible spectrum towards the red end, with consequent lengthening of w.-l. and decrease of frequency. The r. s. in the spectrum of cert. distant nebulae is interpreted by some authorities as evidence of a general recession of these bodies and, consequently, of an expanding universe. See Doppler's Principle.

**Rest mass.** From a relativity standpoint energy is a physical entity capable (1) of an independent existence, (2) of direct association with matter, and (3) of conversion into and of genesis out of matter. The ratio of the mutual transformation is  $e^2$  abs. energy units to 1.0 unit of mass,  $c$  being the vel. of light ( $2.99 \times 10^{10}$  cm. sec.) and  $c^2$  being, therefore,  $8.987 \times 10^{20}$  abs. E. units. Take, by way of example, (a) a blue light wave and (b) a broadcast wave, the former of  $4.7 \times 10^{-5}$  cm. w.-l. and the latter  $5.0 \times 10^4$  cm. w.-l. (see Einstein; Table). In (a) the E of the photon is  $4.2 \times 10^{-13}$  erg; hence  $4.2 \times [10^{-13} : \text{mass } ph] :: 8.97 \times 10^{20} : 1$ . Hence, mass of  $ph = 4.6 \times 10^{-22}$  grams. In (b) E of  $ph = 3.9 \times 10^{-21}$  erg; hence  $3.9 \times 10^{-21} : \text{mass } ph :: 8.97 \times 10^{20} : 1.0$ . Hence mass of  $ph = 4.3 \times 10^{-42}$  g.

**Newtonian mass** is the mass of a body "at rest" or in a moderate state of motion; *einstein mass* is the added mass which a body acquires with increase of vel. towards the limit of the vel. of light. See Mass.

**Rydberg's constant.** Constant figuring in *Balmer's Formula* (q.v.). For the H atom in which proton and electron revolve around a common centre of gravity R is 109,677.76 per cm.; for a nucleus of infinite mass  $R_\infty$  is 109,737.3 per cm. For ionized He  $R_{He}$  is 109,723.403 per cm. For infinite mass (Rydberg's fundamental freq.)  $cR_\infty$  is 109,737.3  $\times 2.998 \times 10^{10} = 3.289 \times 10^{15}$  vibrations per sec.

**Rydberg's fundamental frequency.** See Rydberg's constant.

**Schumann series.** Range of spectrum bands in short ultra-violet region between  $2.2 \times 10^{-4}$  and  $1.2 \times 10^{-4}$  cm. w.-l. Cf. Balmer, Lyman, Paschen.

**Solar system.** Dia.  $1.195 \times 10^{18}$  cm. ( $7.424 \times 10^8$  mi.).

**Circ.**  $3.749 \times 10^{18}$  cm. ( $2.33 \times 10^{10}$  mi.).

*Surf. area*  $4.522 \times 10^{30}$  sq. cm. ( $1.728 \times 10^{30}$  sq. mi.).

*Vol.*  $8.5 \times 10^{44}$  c.c. ( $2.043 \times 10^{39}$  cu. mi.).

*Mass*  $2.0289 \times 10^{33}$  g. ( $1.9967 \times 10^{37}$  l. ton.).

*Density*  $2.354 \times 10^{-12}$  g./c.c. ( $1.889 \times 10^{-12}$  oz. av./cu. in.).

**Sonoluminescence.** Light given out by cert. solutions (e.g. glycerol, nitrobenzol or bromine) when very intense sound-vibrations are passed through them. *See* Luminescence.

*Sun. Dia.*  $1.394 \times 10^{11}$  cm. ( $8.664 \times 10^8$  mi.).

*Circ.*  $4.380 \times 10^{11}$  cm. ( $2.707 \times 10^9$  mi.).

*Surf. area*  $6.154 \times 10^{32}$  sq. cm. ( $2.354 \times 10^{31}$  sq. mi.).

*Vol.*  $1.354 \times 10^{33}$  c.c. ( $8.257 \times 10^{17}$  cu. mi.).

*Mass*  $2.206 \times 10^{33}$  g. ( $1.994 \times 10^{37}$  l. ton.).

*Density*  $1.482$  g./c.c. ( $8.737 \times 10^{-1}$  oz. av./cu. in.).

**Energy:** the energy of 1.9 of matter is  $9.0 \times 10^{40}$  erg.

Hence energy of sun is ca.  $2.026 \times 10^{33} \times 9 \times 10^{30} = 1.82 \times 10^{64}$  erg ( $1.3448 \times 10^{47}$  ft./lb.).

**Thermoluminescence.** Light emitted by cert. minerals and crystals, such as diamonds and fluor-spar, that have been previously exposed to light; X-rays, electrons, or gamma-rays, when they—the minerals and crystals—are slightly heated. The light sometimes appears on simple immersion of the crystal in hot water. Possibly a variety of phosphorescence (q.v.). *See* Luminescence.

**Triboluminescence.** Light of cert. crystals when rubbed or broken. A lump of sugar, broken in the dark, gives out this light. It occurs

whether or not O is present. *Syn.* Piezo-l. *See* Luminescence, Crytallo-l.

**Volt;** absolute. The wave no. associated with one abs. v. =  $8.106 \times 10^3$  per cm. per abs. v. The w.-l. associated with one abs. v. = the reciprocal of wave no., or  $1.2336 \times 10^{-4}$  cm.

**Volt-electron;** absolute. The energy of 1 abs. volt-electron is  $10^6 \times \frac{e}{c}$ ,

where  $e$  = electron charge and  $c$  = vel. light.  $E = 10^6 \times (4.77 \times 10^{-10})$  E.S.U.  $\div 3 \times 10^{10} = 1.591 \times 10^{-4}$  erg. The speed of 1.0 abs. volt-electron =  $5.941 \times 10^7$  cm./sec.

**Water.** Freezing pt.  $0^\circ \text{C}$ ,  $32^\circ \text{F}$ ,  $273.15 \text{ K}$ .

*Pres.* 1.0 in.  $\text{H}_2\text{O}$  at  $4^\circ \text{C}$ . (max. dens.) exerts  $3.6136 \times 10^{-2}$  lb. av./sq. in.;  $5.2022$  lb./sq. ft.;  $25.399$  kg./sq. met.

1.0 cm.  $\text{H}_2\text{O}$  exerts  $1.422317 \times 10^{-3}$  lb./sq. in.; or  $1.0$  g./sq. cm.

1.0 kilom.  $\text{H}_2\text{O}$  exerts  $1.422317 \times 10^3$  lb./sq. in. or  $6.45 \times 10^3$  kilog. per sq. in. or  $10^3$  kg./cm.

1.0 kilom. of sea-water exerts  $1.459356 \times 10^3$  lb./sq. in. or  $1.018 \times 10^3$  kg./sq. cm.

1.0 mile water at  $4^\circ \text{C}$ . exerts  $p. = 2.28898 \times 10^3$  lb./sq. in.; 1.0 mile sea-water exerts  $p. = 2.3474 \times 10^3$  lb./sq. in. Pressure of sea-water at bottom of Swire abyss ( $35,433.0$  ft. or  $5905.5$  fath.) =  $15,728$  lb./sq. in., or  $7.02$  ton/sq. in.

**Yukawa particle.** Mesotron (q.v.). **Zeeman effect.** The splitting up of each single line of a spectrum into multiplets, consisting usually of three finer lines, when the atoms of the source of light are subjected to a powerful magnetic field.



